STRATEGIES USED BY TEACHERS FOR SUPPORTING MATHEMATICALLY GIFTED LEARNERS IN TEN SELECTED HIGH SCHOOLS AROUND BLOEMFONTEIN

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Abstract

Most gifted learners in mathematics fall through the cracks of inclusive classrooms as they are taught by the same methods used to teach both average and slow learners. The needs of the gifted learners are often ignored as teachers believe that they can learn on their own without special programmes. Yet results from many longitudinal studies have confirmed beyond any reasonable doubt that mathematically gifted males and females become the critical human capital needed for driving modern day, conceptual economies. Teachers' strategy is a key element for educators to provide proper learning instructions to gifted learners. However, in South Africa, teachers lamented that they had never received any training on how to deal with gifted learners.

The purpose of this study was to investigate strategies which teachers in ten selected high schools around Bloemfontein, South Africa use when they support mathematically gifted learners in their inclusive classrooms. The researcher used mixed methods to collect information. Data were collected through questionnaires and semi-structured interviews. Nineteen teachers participated in the study. Quantitative data were collected by providing teachers with questionnaires followed by the collection of the qualitative data through semi-structured interviews. Further, ten teachers of these teachers were interviewed. The interviews focused on identifying gifted learners and strategies they used in their classrooms to support mathematically gifted learners. Teachers' responses, from the questionnaires and semi-structured interviews were analysed and compared to establish patterns and themes.

The study found that the prevalent strategy used by teachers to identify gifted learners has been that of tests associated with academic performance. The results also revealed that the most favoured strategy to group learners was the mixed-ability grouping. Though teachers felt they were adequately supporting gifted learners in their classrooms, the study revealed that gifted learners were not given activities that differ from their peers. The results acknowledged both teachers' confidence and frustrations to teach mathematically gifted learners. Teachers felt that having gifted learners gives the opportunity to use them to help struggling learners. Obstacles preventing their efforts to support gifted learners in their classrooms include inadequate personal

knowledge about gifted learners, departmental priorities of catering the needs of other learners and insufficient time to spend with gifted learners.

The study concluded that even though teachers believed that offering gifted learners with challenging activities is important, they struggled to provide gifted learners in their classrooms with suitable challenging work. The researcher recommends that teachers be trained and developed in gifted education.

Keywords: Mathematically gifted learners, teachers' strategies, inclusive classrooms

Dedications

This thesis is dedicated to my mother, Dora Maswantsha Marumo for her unfailing love and support which allowed me to pursue my goals and dreams. You helped me find my footing, which makes me to love you without bound.

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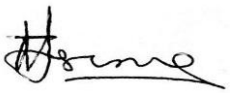
Declaration

I, Jack Mathoga Marumo, do hereby declare that this thesis submitted to the Central University of Technology, Free State for the Degree Master of Education, is my own work; and complies with the Code of Academic Integrity, as well as other relevant policies, procedures, rules and regulations of the Central University of Technology, Free State; and has not been submitted before to any institution by myself or any other person in fulfilment (or partial fulfilment) of the requirements for the attainment of any qualification.



25 September 2018

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SIGNATURE OF STUDENT **DATE**

Jack Mathoga Marumo

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CHAPTER ONE: INTRODUCTION

1.1 Background

During the Apartheid era, South Africa was the only country in sub-Saharan Africa which focused on gifted education where the emphasis was on white gifted learners. Special schools for black gifted learners were established because of the motivation from a 1988 report. However from 1994, the first democratic government shifted the focus from the gifted education to the one that addresses historically disadvantaged groups (Taylor & Kokot, 2000). The post-apartheid policy was aimed at changing the system of education from one that was discriminatory to one that was empowering and inclusive (Powell, Asmal, & James, 2002). The subsequent Education White Paper 6 (Department of Education, 2001) outlined policies where the education system is single and undivided, hoping to provide inclusive education for all learners.

Out of concern for equity, learners with learning disabilities or difficulties should be given special education provision so that they can be developed to their full potential. Although gifted learners are another group which requires special needs, their educational needs are being ignored (Croll & Moses, 2011; Gallagher, 2003; VanTassel-Baska, 1997).

The emphasis on equal opportunity has led to conflict regarding balancing support for gifted and talented learners with minimization of learners' differences. Studies have also referred to the pendulum that swings between equity and excellence, whereby educators are expected to assist gifted learners in reaching their full potential at the same time assisting another group of learners at risk to meet equal minimum educational standards (Lassig, 2009). Although South Africa is believed to be a developing country (Oswald & de Villiers, 2013), it is still faced with educational challenges where educators do not have enough resources to cater for special needs of giftedness and talents. Attitudes often affect perceptions, which are likely to influence behaviour (Bohner & Dickel, 2011). Thus, teachers as the main implementers of education are being researched due to the argument that their strategies for supporting giftedness can affect the whole process of gifted education.

Strategies used by teachers in classrooms play an important role to learners. These strategies can either support or fail learners' growth. This study examines how a gifted learner is being identified including strategies to support mathematically gifted learners. The mixed method research design was used in this study to examine a full view of teachers' practices on gifted learners in mathematics. Teachers from Bloemfontein high schools in Motheo District, Free State, were asked to complete a questionnaire, in order to document the strategies they use. This was followed up by semi-structured interviews.

1.2 The statement of the research problem

Learners with learning difficulties and disabilities are widely provided with special needs so that they can be fully developed (Galloway, Armstrong, & Tomlinson, 2013). Although gifted and talented are another group of learners that need a special education, their needs are ignored (Kokot & Kruger, 2005). Teachers' strategy is a critical component for educators to provide proper learning instructions to gifted learners. However, teachers interviewed by Oswald and de Villiers (2013) indicated that they were never trained on how to deal with gifted learners. Given this gap, it is important to investigate strategies and methods used by teachers to teach gifted learners in their inclusive classrooms.

1.3 Purpose of the study

The purpose of this study was to investigate strategies which teachers use when they support mathematically gifted learners in their inclusive classrooms.

1.4 Research questions

i) How do teachers identify gifted learners in mathematics?
ii) What instructional strategies do teachers use for supporting mathematically gifted learners?
iii) To what extent are teachers' instructional strategies meeting the needs of the gifted learners?

1.5 Objectives of the study

i) To investigate strategies which teachers use to identify gifted learners in mathematics classrooms
ii) To investigate instructional strategies which teachers use when they support mathematically gifted learners in their classrooms
iii) To compare and contrast current teacher strategies with expected strategies in order to determine the extent to which current strategies are meeting the needs of the gifted learners.

1.6 The significance of the study

This study is important in many ways. A lot of research has been done on how teachers' practices meet the needs of gifted learners (Jolly & Matthews, 2012), but there is scarce information about these practices in high schools around Motheo District. Similarly, the National Planning Commission (NPC, 2010) in South Africa recognised that gifted learners were a key element of the country's capability which the teachers have overlooked in the regular classrooms (Mhlolo, 2018). In response to the findings of the NPC, the Department of Basic Education (DBE, 2013) recommended that the revised national Mathematics, Science and Technology (MST) strategy should accommodate the MST talent development programmes. Furthermore, the Mathematics, Science and Technology Education (MSTE) suggested that each province in the country should have at least one special institution for MST. Mhlolo (2018) indicated that having an institution for gifted and talented learners before training teachers, would be like putting the cart before the horse. The recommendations of this study are intended to assist both policy makers and the DBE to effectively deal with the problem.

Several researchers (Mandelman, Tan, Aljughaiman, & Grigorenko, 2010; Meisenberg & Lynn, 2011; Rindermann & Thompson, 2011) have studied about the critical role of gifted and talented classes in developing and transforming societies. These studies have shown that cognitive ability levels of societies are required for the development of positive valued aspect of any developed or developing countries like South Africa. Gifted learners are the smart fraction of a

country and not only more relevant than the average cognitive ability level, but also for the Gross Domestic Product (GDP) of the country. For the general human development level of a society, the 95th level is less important than the average but more important than the 5th level (Rindermann, Sailer, & Thompson, 2009). Like any other developing country, the progress of South Africa's economy is also heavily relying on its mathematically gifted learners. This study will aid teachers in identifying this smart fraction of the population.

Education for gifted learners has a long history in Singapore. Even though Singapore is a small island nation in Southeast Asia, initiatives in recent years have sought to extend and diversify opportunities of gifted programmes for more learners across many domains. The government of Singapore believes that only top achievers on curriculum-based standardized examinations qualify to be identified as gifted learners (Ibata-Arens, 2012), hence it supports schools in differentiating instruction for gifted learners in mainstream classrooms. There are three main reasons for the Minister of Education to implement a Gifted Education Program (GEP) in Singapore. Firstly, it was believed that gifted learners needed a level of challenge that cannot be met in the regular classroom. Second, since Singapore is very small without natural resources, with only human resources to rely on for its success, meeting the needs of gifted learners was seen as essential for the country's success. Third, although Singaporeans are aware that gifted learners are already excelling, there are instances where these learners are not developed to their full potential. Provisions for gifted learners do not end at high schools, universities also offer differentiated programs for gifted students and train teachers in gifted education (Neihart & Tan, 2016). Professionals and public do not resist the idea of a highly differentiated education system and the high achieving independent academies and specialist high schools are not considered to be elitist. Singaporean learners have a high standard of achievement with the majority outperforming their international peers in mathematics and science. It is against this background that this study will serve as a source of reference for other researchers intending to study the practices of teachers in meeting the needs of gifted learners in mathematics.

1.7 Research methodology and design

1.7.1 Research methodology

The study used mixed methodology in order to gain the participants' experiences of identification and support given to gifted learners in mathematics classrooms. Quantitative research is an approach which uses methods to collect numerical information in order to generalise to a broader population. Qualitative research employs methods which looks in depth at fewer subjects through rich description of their experience and perceptions.

1.7.2 Research design

Making use of a most suitable research design ensures that the actual research is conducted in a methodological manner and the relevant data regarding strategies used by teachers to support gifted learners is gathered. The study employed mixed-methodology to assist in obtaining information to answer research questions.

1.7.3 Research data collection instrument

The main research data collection instruments were questionnaires and interviews.

1.7.4 Population

A study population refers to the entire group of individuals to whom the findings of a study apply. The population used in this study were grade 10 mathematics teachers in high schools around Bloemfontein, in the Motheo municipality, Free State Province.

1.7.5 Sample

A sample is a part of the population that shows a true reflection of the full picture. The researcher used purposive sampling, which is selecting information-rich cases for the study. Twenty teachers in grade 10 mathematics classrooms were selected

from high schools around Bloemfontein to participate in the study. McMillan and Schumacher (2014) argue that purposeful sampling is aimed at increasing the utility of information collected from a small sample. Mhlolo (2012) adds that it is based on the researcher's judgement in that a sample is composed of elements that contain the characteristics that are most representative of typical attributed of the population.

1.7.6 Data collection process

Questionnaires and face to face interviews were employed for this study. The researcher visited ten high schools and personally distributed questionnaires to twenty high schools' teachers in grade 10 mathematics classrooms. The respondents completed the questionnaire at their own place and time. Nineteen responses were received. Following the responses on the questionnaires, ten teachers were interviewed.

1.7.7 Data analysis

The quantitative data collected through questionnaires was analysed through descriptive statistics. The qualitative data collected from the interviews were thematically analysed. The researcher identified themes by reading and re-reading the transcribed interviews and grouped the teachers' responses into the patterns. The patterns were categorised, and these categories were condensed into themes for analyses.

1.8 Definitions of terms

Enrichment programmes are programmes that supplement normal grade level by providing richer and more varied content through different strategies.

Giftedness, as defined in the Differentiated Model of Giftedness and Talent (DMTG), designates the possession and use of untrained and spontaneously expressed natural abilities, in at least one ability domain, to a degree that places an individual in at least 10% of age peers" (Gagné, 2008).

A learner is one who gains knowledge through a knowledgeable person and in the context of this study is in the tenth grade in school.

A regular classroom is a mainstream classroom within a high school with an average of 35 learners with varying learning abilities per teacher.

Talent designates the outstanding mastery of systematically developed competencies (knowledge and skills) in at least one field of human activity to a degree that places an individual at least the top 10% of learning peers (Gagné, 2008).

1.9 Ethical considerations

The researcher received permission to conduct the study from the officials of the Department of Education and the principals of high schools in Motheo District (see appendix D). The researcher also assured the participants that the study is for the academic purpose and that utmost confidentiality would be observed.

1.10 Limitations of the study

The study focused on strategies used by teachers to support gifted learners in their mathematics classrooms. Teachers were drawn from grade 10 mathematics teachers in only 10 high schools around Bloemfontein in the Free State. Since the results are based on a relatively small sample drawn from one city (Bloemfontein), generalization is not intended for a wider population. However, these results are consistent with literature findings and are similar to other studies conducted with large samples. The study was conducted between 2016 and 2018, therefore the results reflect the strategies used by the teachers to support mathematically gifted learners at that time.

1.11 Delimitation of the study

The researcher had determined that no study on strategies used by teachers for supporting mathematically gifted learners in high schools around Bloemfontein had been done yet. This study focused on ten high schools. The schools targeted to form part of this study are located in Mangaung municipality in the Free State Province, South Africa.

1.12 Structure of the study

The study consists of five chapters. The chapters are organized in the following format:

1.12.1 Chapter 1 – Introduction

In this chapter, the researcher introduces the reader to the background of the inclusive education in South Africa. The chapter then provides the statement of the research problem, research questions, objectives of the study, significance of the study, research design, research methodology and a definition of key terms.

1.12.2 Chapter 2 – Literature Review

Chapter two begins with an overview of inclusive education globally. It highlights the importance of the guiding framework of the World Conference on Special Needs of Education in 1994 in Salamanca which was held in Spain. The guiding principle argues that all schools should cater for all learners regardless of their intellectual and physical conditions, and this should include gifted and disabled children. The chapter then focuses on how inclusive education was instituted in South Africa during curriculum changes by the government led by the African National Conference. Even though the new constitution of the country emphasizes on the recognition of diversity, the literature review argues that a number of small groups which includes the gifted learners, continue to experience barriers in learning and are vulnerable within existing arrangements. While Gagne's (2015) frame work provides a description of a gifted learner, teaching mathematics to gifted learners

does not seem easy. To minimize the anticipated challenges, teachers should pay attention to many things like their needs and abilities. For this reason, the literature review finally pays attention at how teachers identify and support gifted learners to prevent some challenges in inclusive classrooms.

1.12.3 Chapter 3 – Methodology

In this chapter, the researcher begins by justifying why the mixed method methodology was chosen for this study. Taking into account the purpose of the research which was to investigate strategies which teachers use when they support mathematically gifted learners in their inclusive classrooms, the researcher decided to involve both quantitative and qualitative methods for data collection as suggested by Creswell (2013). The two data collection instruments that were used in the study will be reviewed, namely a questionnaire and semi-structured interviews. Lastly, the sample selection procedures and analyzing data will be provided.

1.12.4 Chapter 4 – Results Analysis

The results of the study will be presented in this chapter

1.12.5 Chapter 5–Discussion of Results, Conclusion, and Recommendations

Chapter five provides a discussion of the findings as analyzed in terms of the literature review in chapter two. The questionnaire and interviews were focused on strategies used by teachers to support mathematically gifted learners. The discussion focuses on how teachers identify gifted learners in their mathematics classrooms, the strategies for supporting such learners and to what extent are those strategies meet the needs of gifted learners. The chapter also provides conclusions and recommendations drawn from the study.

CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

The present study focused on strategies used by teachers for supporting mathematically gifted learners. This chapter deals with the literature review related to the research questions and literature that deals with the general and where possible the applicable strategies to support gifted learners. The purpose of this chapter was to inform the researcher on what has already been achieved in the giftedness field by other researchers. The chapter is divided into the following parts: inclusive education globally, inclusive education in South Africa, the Differentiated Model of Giftedness and Talent (DMGT) Rationale, Gagné's Metric Based System, Identification of a gifted learner in mathematics, ways used by teachers to deal with gifted learners in their classrooms and summary of the literature review.

2.2 The theoretical framework

The importance of theoretical framework cannot be over emphasised in any research work because it is one of the most important aspect in the research process. The use of a theoretical frame work improves the internal logical consistency of a research activity and it is linked to the research problem of the study, hence it must be identified at the beginning of the study. Ravitch and Carl (2015) argued that the theoretical framework assists the researcher in positioning and contextualizing formal theories into his/her study as a guide. Moreover, the theoretical framework helps the reader to understand the researcher's decisions about the study topic, assumptions and how the approach was conceptually grounded. Imenda (2014) clearly states that a research without the theoretical framework lacks accurate direction to the search of appropriate literature and scholarly discussion. Though certain theories are popular, Simon and Goes (2011) maintain that the adoption or adaptation of a theory must show the understanding of the researcher regarding the study and must guide the study. So, what theoretical framework guided this study?

While there are several theories and models on gifted education, Gagné's (1999) Differentiated Model of Giftedness and Talent (DMTG), is among the top six that have been considered dominant in affecting international classroom practice. For more than three decades, Gagné studied giftedness in many cases including in a regular classroom and attributed the neglect for gifted learners to a failure to distinguish between 'gifts' on one hand and 'talents' on the other. According to Gagné (2015), these terms are often used synonymously, yet there is a clear and appropriate distinction to be gainfully made. Gagné argued that 'one term fits all' was inaccurate and detrimental to all efforts to identify and support talent, because it suggests that talents are inborn hence there is no place for systematic training, learning and practicing. His argument is that an interchangeable use of these terms suggests that talent or ability has appeared without any systematic learning or teaching and those who possess such gifts have somehow been endowed with a particular ability in a way that is beyond the control or scope of education (Sternberg, 2003). Based on his contention, Gagne (2015) proposed a model for understanding the education for gifted students, which he called the Differentiated Model of Giftedness and Talent (DMTG) and is used by many other researchers interested in giftedness and talent. Gagne's DMTG tries to make a distinction between outstanding natural abilities referred to as '' aptitudes'' and specific expert skills referred to as ''competencies''. Although there are disagreements here and there, the DMTG has received worldwide recognition because it is viewed as resolving the controversies that the gifted field has struggled with for years (Pfeiffer, 2013). Therefore, this study considered the DMTG as a suitable framework as shown in figure 2.1.

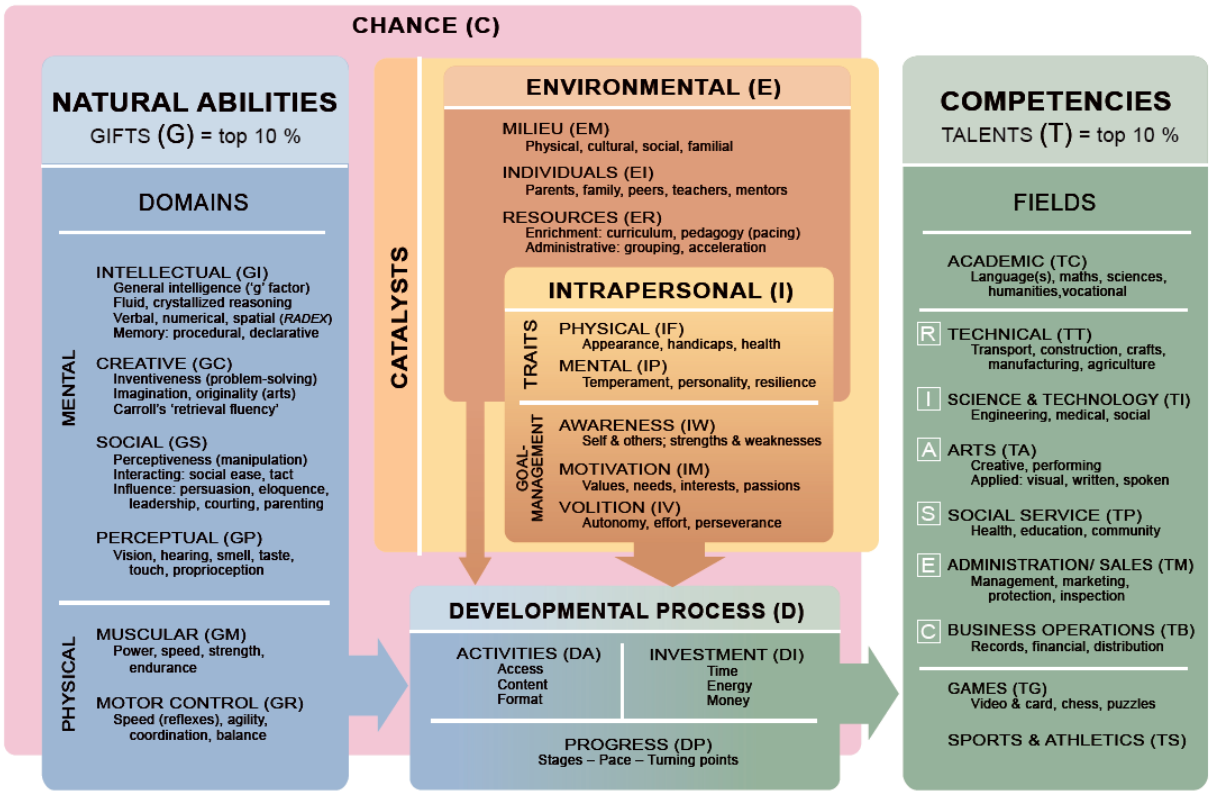


Figure 2. 1: The Differentiated Model of Giftedness and Talent (Gagné 2015).

According to Gagné (2008; 2004), *giftedness* is described as a natural ability that can be developed fully by the appropriate and supporting environment (catalysts) into a talent. Gagné (2010) describes giftedness as a raw capacity. On the contrary, Gagné (2015) describes *talent* as not only involving natural ability but also outstanding mastery of systematically developed abilities (knowledge and skills) in at least one field of human activity to a level that places an individual's achievement at least among the top 10 % of age peers who are active in the same field. Talents are developed from aptitudes through formal or informal education and training (Gagné, 2004).

Figure 2.1 shows the progression from Gifts (G) to Talents (T) which is facilitated by the Developmental Process (D). Two Catalysts, the Environmental (E) factor, and the Intrapersonal (I) factor either hinder or facilitate the developmental process. The Chance(C) component is another factor which can significantly impact all the contributing components of the DMGT model. Intellectual (GI), Creative (GC), Socio-affective (GS) and Sensorimotor (GM) are four domains of the natural

abilities. These aptitudes have genetic roots and can be observed in every task given to learners (Gagné, 2010). Gagné argues that if the Developmental D is weak, then gifts will never transform into talent. Within the Developmental Process D, teachers play a critical role.

The Developmental Process (D) described in the DMTG 2.0 consists of three subcomponents. These subcomponents are Activities (DA), Progress (DP) and investment (DI) (Gagné, 2010, 2011, 2012). Activities relate to the access, content and format of specialised learning experiences that are offered for gifted learners. The development of talent can be triggered when the learner can access, through the identification process or being decided on to a program that is focused on talent – development tasks. Through these tasks the learner is presented with material that is relevant for their needs, whilst being given within a particular learning environment. The learning environment that is typically found within schools is structured (Gagné, 2011, 2012).

The Progress (DP) of talented learners refers to stages, pace and turning points (Gagné, 2011, 2012). Stages in the development can be determined from the progress that the learner encounters from initial access to the mastering performance. This progress can be broken down into a series of Stages (DPS) – novice, advanced, proficient and expert (Gagné, 2011, 2012, 2015). Schools have adopted geographically based system of stages ranging from local mathematics competitions, followed by provincial, national, and international mathematics competitions. The measurement of pace (DPP) constitutes the main quantitative representation of talented learner's progress within and between developmental stages with teachers being able to assess pace with both ipsative and normative measures (Gagné, 2011, 2012). Therefore, talented learners can measure their ipsative progress so that they can make improvements to and on previous accomplishments, however normative assessments are usually the rule: such as comparing the talented learners' progress against similar peers or average learners who are doing the same subject (Gagné, 2011, 2012).

The Investment (DI) sub-component concentrates on the strength of the talent development process with regards to time (DIT), money (DIM) or psychological

energy (DIE). The amount that is invested, the financial support provided, and the psychological energy expended throughout development often result in longitudinal curves – with evolution over weeks, months and years showing increases or decreases as time go on, and brings about differences between learners (Gagné, 2011, 2012, 2015). The investment provided is a crucial component in talent development, as it can affect opportunities available. Gagne (2012) maintains that the energy construct is less easy to operationalise as it could be assessed as passion, concentration during teaching or determination to succeed.

Educators have critical roles in improving the environmental milieu and boosting the learners' personal traits to achieve their maximum level of talent development from the capabilities of giftedness. As educating is much more than mere teaching, it is necessary for teachers to become supportive to their learners' demands and accommodate their needs in order to nurture learners' intra and interpersonal abilities that are the essential components in developing gifts into talent as proposed by the Differentiated Model of Talent Development (DMTG).

2.3 Relevance of the DMTG in this study

The goal of good research is not simply to describe the adopted theoretical framework for a study, but it is important for the researcher to show the relationship of the selected theory and the study. Simon and Goes (2011) concur that theoretical frameworks deepen the essence of the study. Therefore, the researcher must clearly show the criteria of selecting and applying the theory, and that criteria must be appropriate, well understood and logically interpreted.

As it has already been highlighted, the adoption of the DMGT model deepens the essence of this study in many ways. The DMGT suggests that while high ability (talent) has some genetics basis (giftedness), learning, practice and environmental factors are essential for the emergence and development of such talent. The development process can be influenced by the way catalysts are managed either directly or indirectly, meaning that a learner's potential can either be developed or hindered by environmental and intrapersonal catalysts. This conceptualisation of the gifts-talent continuum through the catalysts enables any researcher interested

in investigating (a) the physical, cultural or social environment, (b) the teachers, parents, peers as individuals who manage the other non-human catalysts and then (c) the gifted learners themselves in terms of their temperament, personality and motivation (Mhlolo & Mhlolo, 2018). The study's research questions fit very nicely into this framework as the researcher asks a question about teachers as mangers and catalysts of the regular classrooms that should provide resources for gifted learners. The DMTG features the 'best' practice that talent development programs should implement, suggesting that there is an ideal template against which this study can compare its findings. This ideal template also helped the researcher to be more specific in the development of the data collection tools.

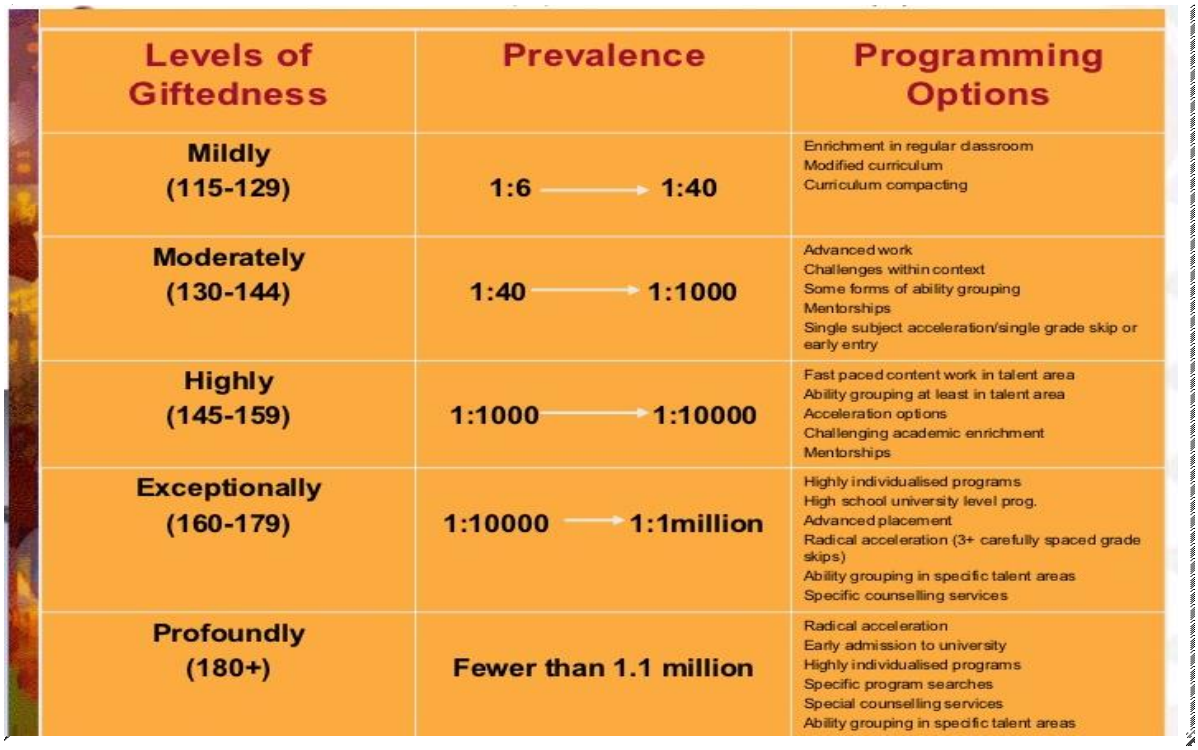
Despite the distinction between giftedness and talent listed above, other researchers (Balchin, Hymer, & Matthews, 2009) question the meaning of giftedness or intelligence, whilst not overlooking the importance of psychological, social and emotional development. A similar controversial question that teachers and scholars in the field of gifted education have been asking is: 'How best can a gifted learner be identified from his or her peers?' Identification of gifted and talented children was initially based on the use of intelligence test (IQ test). However, the use of IQ tests has received much criticism over the years. Criticism have ranged from the claim that IQ test are unfair to those who are disadvantaged, to the claim that the tests minimize the importance of creativity, practical intelligence and morality Reschly, 1984). Renzulli was among the first to say that the gifted field's exclusive emphasis on high IQ was misguided because intelligence tests and standardized tests may lack in ecological validity due to cultural or linguistic diversity. The 'cultural specifity' of intelligence makes IQ tests biased towards the environment in which they were created – namely white, Western society. In an effort to respond to this concern, Gagné (2015) proposed a metric-based system (MBS) of intensity levels (table 2.1) whose minimum threshold is fixed at 10%. This has led to development of the 5 degrees of giftedness, which has been useful for researchers in terms of identifying gifted learners within regular classrooms. They are labelled mildly 10% (top 1:10), moderately 1% (top 1:100), highly 0.1% (top 1:1000), exceptionally 0.01% (top 1: 10 000), and extremely 0.001% (top 1: 100 000). Gagne (2015) considers a prevalence estimate is integral because this allows a scholar to determine the limit separating those who are relevant to the level from

those who are not. Gagne chose 10% in part, as it was between 1% used by Terman (1928) and the 20% suggested by Renzulli (2005).

Table 2. 1: Levels of Giftedness in the Metric Based System

Level of Giftedness	Labels for Giftedness	Proportions
5	Extremely (Profoundly)	1: 100 000
4	Exceptionally	1: 100 00
3	Highly	1: 100 0
2	Moderately	1: 100
1	Mildly	1: 10

In addition to Gagné's MBS, Gross (1998) argued that there are five levels of ability within giftedness, including mildly, moderately, highly, exceptionally and profoundly that require different types and levels of response. Feldhusen (1993) described these programming options for each level of giftedness (figure 2.2).



Levels of Giftedness	Prevalence	Programming Options
Mildly (115-129)	1:6 → 1:40	Enrichment in regular classroom Modified curriculum Curriculum compacting
Moderately (130-144)	1:40 → 1:1000	Advanced work Challenges within context Some forms of ability grouping Mentorships Single subject acceleration/single grade skip or early entry
Highly (145-159)	1:1000 → 1:10000	Fast paced content work in talent area Ability grouping at least in talent area Acceleration options Challenging academic enrichment Mentorships
Exceptionally (160-179)	1:10000 → 1:1million	Highly individualised programs High school university level prog. Advanced placement Radical acceleration (3+ carefully spaced grade skips) Ability grouping in specific talent areas Specific counselling services
Profoundly (180+)	Fewer than 1.1 million	Radical acceleration Early admission to university Highly individualised programs Specific program searches Special counselling services Ability grouping in specific talent areas

Figure 2. 2: Levels of Giftedness Prevalence & Programming Options (Feldhusen, 1993)

Feldhusen outlines the prevalence of each level within the population and the most appropriate programming options when supporting for each level's educational requirements. This is important to the field of gifted education as it suggests what needs to be done with gifted learners at different levels. Using this MBS, Gagné argued that the minimum threshold for any giftedness is placed at ninetieth (90^{th}) percentile, thus those learners who belong to the 10% of the reference group in terms of their natural abilities deserve the relevant label (Gagné, 2015). In practice, it can be deduced that 4 top achievers in an inclusive classroom of 40 learners are mildly gifted. Some teachers may regard the use of this 10% as overly generous (Gagné, 2007). This generosity is counterbalanced by adding more subgroups where 4 top achievers out of 400 learners are regarded as moderately gifted. These top 10% learners who demonstrate relatively high mathematical ability deserve the label of mildly gifted and are called gifted learners in this study.

The focus on the 'mildly gifted learners' follows Gagné's recommendation that the clear majority (90%) of the gifted/talented individuals belong to this lowest level while the highly gifted/talented (1:100,000) individuals are a rarity. His concern was that when we present extreme examples of behaviour to parents or teacher, we risk conveying a distorted to image of the 'garden variety' of gifted individuals because stakeholders would be tempted to judge that such a rare population does not justify large investments of time and money to meet their educational needs. Gagné (2010) therefore recommended that gifted and talented program coordinators should think first and foremost about services for their mildly gifted learners. In educational systems that are guided by inclusive philosophy, the 'garden-variety' of gifted learners spend most of their time in regular classrooms hence it can be argued that every teacher should be regarded as a teacher of at least the mildly gifted.

2.4 Inclusive education Globally

Inclusive education is now a global phenomenon which gained more momentum at the World Conference on Special Needs of Education in 1994 in Salamanca, Spain (Unesco, 1994). Its purpose is to guide actions by governments, international and organizations, non-governmental organizations (NGOs) and other bodies in implementing the Salamanca Statement on Principles, Policy, and Practices in

Special Needs Education. According to the Salamanca Declaration and inclusive schools, inclusive education requires that:

> *"…Schools should accommodate all children regardless of their physical, intellectual, social, emotional, linguistic or other conditions. This should include disabled and gifted children, street and working children, children from remote or nomadic population, children from linguistic, ethnic and cultural minorities, or children from disadvantaged or marginalized areas or groups."* (The Salamanca Statement and Framework for Action on Special Needs Education, para 3)

The guiding principle that informs its Framework is that all schools should cater for all learners regardless of their intellectual and physical conditions, and this should include gifted and disabled children. The Framework for Action on Special Needs Education assumes that many learners experience learning difficulties and thus have special educational needs at some time during their schooling. The emerging consensus that children and youth with special needs be included in the educational arrangements, has led to the concept of the inclusive education in schools.

This has benefited many education officials all over the world to begin establishing and implementing inclusive strategies in education system in their countries (UNESCO, 2006). As the nations worldwide are approaching inclusive education strategies, and being assisted by many international declarations, equipping teachers for this role has become a key issue. This is based on the fact that regardless of what the policy will say and teaching materials being provided for inclusion, still teachers are standing as a single factor for a meaningful implementation of inclusive classroom (Kaplan, 2013). This kind of expertise and skills is mainly developed and presented during initial teachers training.

2.5 Inclusive education in South Africa

The implementation of inclusive education in South Africa was instituted during curriculum changes by the government led by the African National Conference (Naicker, 2005). Transformation of the South African society with the initiation of inclusive education was in line with Salamanca Statement of 1994 (Engelbrecht,

2006). To ensure the implementation, the government drafted policies as indicated in the White Paper 6 (Department of Education, 2001). The implementation process of inclusive education in South Africa can be summarised as follows (Landsberg, Krüger, & Nel, 2005):

> *The White paper on Education and Training in a Democratic South Africa (1955); the South African Schools Act 84 of 1996; The White Paper on an Integrated National Disability Strategy (INDS) (1997); the National Commission Special Needs and Training (1997); the National Committee on Education Support Services (1997); the Education White Paper 6 Special Needs Education: building an inclusive education and training system (2011); the Draft National Disability Policy Framework (2008); Guidelines for the implementation of National Disability Framework (2008) and The United Nations on rights of Persons with Disabilities (2006) ratified by South Africa in 2007.*

White Paper 6 (Department of Education, 2001) clearly states that for inclusive education to be a reality, there ought to be a conceptual change concerning the provision of support for learners that encounter difficulties in learning. The strategy that the Department of Education has adopted aimed at steering the implementation of policies concerning inclusive education. This policy has two major elements which are clarified in two sets of guidelines:

The National Strategy on screening, Identification, Assessment and Support (SIAS) guides inclusive eduaction policy by describing how teachers should identify and assess learners in schools (Department of Education, 2008). The SIAS stratergy offers guidelines to schools on early identificattion and support required by learners and also the guidelines on the central role of teachers in implementing the strategy (Dalton, Mckenzie, & Kahonde, 2012).

The Guidelines for Responding to Learner Diversity in the Classroom through Curriculum and Assessment Policy offer practical guidelines to education officials and teachers on planning to meet the needs of a diverse range of learners in classrooms (Department of Education, 2011). This document has been reviewed to include curriculum adjustments in the Curriculum and Assessment Policy Statement

(CAPS) and the up-dated serves as a part of th CAPS (Dalton et al., 2012) orientation programme for school managers and teachers around the country.

Regardless of the enabling policies outlined above, it seems that in South Africa, implementing inclusive eduaction has challenges (Dalton et al., 2012; Wildeman & Nomdo, 2007), and the difficulties arise from number of reasons such as lack of teachers' training and workshops, and issues that affect the education system at large including the role of special schools. Even though some teachers are found to understand inclusive education, other teachers do not have the knowledge and understanding thereof (Mayaba, 2010). Moreover, the new constitution emphasizes on the recognition of diversity. This implies an inclusive approach to education where all learners are entitled to an environment that is inclusive and supportive.

Nevertheless, more than a decade following the introduction of Education White Paper 6, most learners with giftedness who attend mathematics in regular classrooms are still having learning problems. There is no consensus regarding who should and should not be classified as a gifted learner in South Africa. The difference in opinion causes confusion in terms of identifying and supporting this group of learners. It does not come as a surprise then that gifted education in the country has gained very little attention ever since post-apartheid. The current situation of gifted education in South Africa is regarded as not motivating (Mhlolo, 2015; Oswald & de Villiers, 2013; van der Westhuizen & Maree, 2006) and the unfortunate situation of the gifted learners is hardly considered even though for some other reasons they experience barriers in learning and are vulnerable within existing arrangements.

2.6 Identification of a gifted learner in mathematics

Teachers' nominations play an important role in identifying a specific ability, such as the ability in mathematics. Teachers might nominate learners based on the extent of learners' performance (Heller, Perleth, & Lim, 2005). Eyre (2001) suggested that the 'diagnostic assessment' as one of the broad forms of information available in schools be used to overcome problems associated with different tests. The diagnostic assessment helps teachers in identifying some aspects when it is used with the work produced by the learner (in the form of a portfolio) and teachers'

classroom when observing learners characteristics during question and answer sessions as suggested by VanTassel-Baska (2007).

Several characteristics are used to identify gifted learners in a particular field. Even though mathematically gifted learners are not a homogeneous group, they share some common characteristics (Phillipson & Callingham, 2009; Sriraman, 2005). Depending on this fact, the following characteristics will be discussed in this study:

2.6.1 Mathematical Creativity Abilities

Psychologists' have associated creativity with intelligence (Sternberg, 1985), ability to abstract and generalize and solve complex problems (Sternberg & Frensch, 2014). However, like many other terms, there are many definitions and descriptions (Mann, 2006; Sriraman, 2005). Sternberg and Lubart (1999) view creativity as the ability to produce a useful original work. Most giftedness models emphasize originality in the manifestation of creativity (Davidson, 2009; Subotnik, Olszewski-Kubilius, & Worrell, 2011). In his definition, Krutetskii (1977) emphasize the role of independence in the creativity. He further states that mathematical giftedness is branded by generalized, partial and flexibly using the mind to relate mathematical letter symbols and numbers. Krutetskii is in agreement with Gagné (2015) that although anyone can be an ordinary mathematician, one must be born an exceptional mathematician. Krutetskii acknowledges that the ability to: a) shorten mathematical reasoning, b) remember mathematical methods and principles, c) go all out for clarity and simplicity of solutions, d) generalize mathematical activity swiftly and systematically and e) reverse and restructure mental process, are interconnected and characterize mathematical giftedness. Thus, a systematic and focused activity is required also for individuals who excel well in their fields. Krutetskii work is in line with Leikin (2009) which assumes that mathematical creativity is a dynamic belonging of a human mind that can be developed or shattered.

Leikin (2009) suggested that mathematical creativity be viewed through the eye of Multiple Solution Task where a learner is expected to solve a mathematical problem using different approaches. The desire to use different approaches, persistence and

being more cognitive resourceful, are all characteristics of the potential creative mathematical thinker recognized by (Carlton, 1959). The hidden creativity can go unnoticed in a regular classroom and Kim, Cho and Ahn (2004) claim that traditional methods to identify mathematically gifted learners do not identify mathematical creativity, but rather value accuracy and speed. This indicates that giftedness in mathematics is gauged within the education system by computational skill, with minimal emphasis on creativity and problem solving. Teachers who consider giftedness in mathematics as the ability to compute accurately find little or no reason to learners with opportunities to engage on tasks that demand divergent thinking. Confining the identification of giftedness in mathematics to the traditional tests neglects the very group of learners who offer the greatest potential for the improvement of mathematics in the regular classrooms (Mann, 2009).

2.6.2 Mathematical Reasoning

The impact of mathematical reasoning on mathematical education has been studied from multiple perspectives (Johansson, 2016). According to Chamberlin and Moon (2005), mathematically gifted learners have their unique links to solve mathematical tasks. Learners that are gifted in mathematics are capable of compressing the process of mathematical reasoning by leaving out intermediate steps in the process (Krutetskiĭ, Wirszup, & Kilpatrick, 1976). Krutetskii further argues that these learners strive to find the easiest, clearest and most economical way to find the solution of the problem. Further to Krutetskii work, Borovik and Gardiner (2007) asserted that ability to shorten the method hinders the risk of the learners being misunderstood or marked incorrectly.

2.6.3 Problem-Solving Abilities

The definitions of problem-solving and associated terms differ in the literature. For example, Sternberg (1995) and Killen (2006), describe the problem-solving process as a kind of inquiry learning where existing knowledge is applied to the unfamiliar situation in order to gain new knowledge. Wilson (2000) describes problem solving process as attempts made by the learner to get to a solution by using thinking, reasoning and carrying out the plan during this process. Moreover, Davidson,

Sternberg and Sternberg (2003) defined problem-solving process as the situations or conditions where learners solve their problems they come across by utilising their own knowledge and experiences. The problem-solving process starts when a learner realises that he or she should react to a target. The way an individual perceive himself or herself during problem solving, how he focuses on problem, the level of self-confidence, the ability to create solutions and making decisions, affect the process of solving problem (Uçar, Uçar, & Çalişkan, 2017). The abilities which are needed by problem-solving process vary from learner to learner or problem to problem, and the process have some basic and general phases.

With respect to problem-solving abilities, Polya's (1957) model of problem-solving shows that when solving a mathematical problem, learners undergo four phases: a) understanding the problem, b) planning to solve the problem, c) carrying out the plan and d) looking back. The study carried out by Szabo (2015) indicates that mathematically gifted learners follow the Polya's model when solving new and challenging mathematical problems. In their study similar to that of Szabo (2015), Lee and Hwang (2005) add that gifted learners in a regular classroom differ with their peers not only in the problem-solving ability but also in problem finding and problem posing abilities. In contrast, gifted learners in mathematics are flexible and think out of the box during mathematical problem solving (Brandl, 2011; Leikin, 2014).

In order to discover the structure of mathematical ability, Krutetskiĭ's (1976) study observed learners at qualitative different levels which include groups of mathematically capable, relatively average and incapable learners were singled out. The study focused at the learners' problem-solving activities and Krutetskiĭ (1976) developed a framework that defines mathematical ability as a complex phenomenon, with the following components:

a) The ability to acquire mathematical information (i.e. formalised perception of mathematics)
b) The ability to process mathematical information (i.e. rapid and broad generalisation of mathematics objects, relations flexibility in mental process, and pursuing for clarity and simplicity solutions)

c) The ability to retain mathematical information (i.e. mathematical memory which is a generalised memory for mathematical relationships, type of relationships and proofs and methods of problem solving) and
d) A general synthetic component, referred to as a mathematical cast of mind.

(Krutetskiĭ (1976)

Furthermore, Krutetskiĭ (1976) categorized gifted learners in mathematics as analytic, geometric and harmonic. The analytic learners enjoy solving problems by abstract construction and are more successful at abstract problems. Unlike analytic type, the geometric learners tend to solve problems by visualizing (diagrams and graphs). The harmonic learners display the characteristics of both the analytic and geometric learners.

Finally, though Krutetskiĭ (1976) study on problem-solving was concluded in the 1960's, it is important to indicate that other researchers (Deal & Wismer, 2010; Heinze, 2005; Leikin, 2010) continue to work on Krutetskiĭ concepts and extend his work. Even more, Juter and Srriraman (2011), and Sheffield (2002) studies on the characteristics of mathematically gifted learners show principal similarities with Krutetskiĭ's main ideas. Sheffield (2002) concludes that, during problem solving process, mathematically gifted learners demonstrate:

a) Mathematical frame of mind (i.e. the learner enjoys working with mathematical patterns and see mathematics in a variety of everyday situations)
b) Mathematical formalisation and generalisation (i.e. generalising the structure of a problem often from only g a few given example, thinking logically and developing proofs and arguments)
c) Mathematical creativity (i.e. process information flexibly, exhibiting original approaches to problem solving, reversing process)
d) Mathematical curiosity and perseverance (i.e. curiosity about mathematical relationships and showing persistence when solving difficult problems)

(Sheffield, 2002; Szabo, 2017)

2.6.4 Attitudes towards mathematics

With respect to attitudes, studies have shown that learners that are gifted in mathematics hold positive attitudes (Choi & Do, 2008) and have interest and passion in mathematics. Choi (2009) carried out a study on characteristics of Korean mathematically gifted high school learners and the results revealed that the participants were confident, persistent, self-disciplined, diligent and competitive. The participants also illustrated characteristics of reading books related to mathematics, solving mathematical problems and performing calculations faster than their peers. Choi (2009) adds that in order to identify learners that are gifted in mathematics, teachers need to know these characteristics.

Hung (2004) also conducted a study with the purpose to investigate the characteristics of gifted learners in mathematics during problem-solving. Participants were 207 of which 92 were regular learners from a primary school in Taipei and 117 were elected from the Pre-Semi-final of 2003 Asia Pacific Mathematical Olympiad for Primary school in Taiwan. The results revealed that the group of gifted learners differed with that of the regular learners in their emotional and affective characteristics. The group of gifted learners exhibited interest in solving problems, confidence throughout the problem-solving process and enjoyed mathematics tests.

2.7 How should teachers support mathematically gifted learners?

Teachers need to look at ways that are suitable for varied levels of learning in the mathematics classrooms. For example, teacher strategies include grouping learners and providing learners with sufficient and broad challenging experiences (Marumo, 2017) which enhance the learning of all learners. Thus, differentiation is the process by which curriculum objectives, teaching methods, assessment methods, resources and learning activities are planned to cater for the needs of all individuals in ways which meet their needs. Rotigel and Fello (2004) give an example of differentiation in teaching, they explain that for example when calculating the area of polygons, the average learner is taught the basic formula: this approach requires low order thinking skill. On the other hand, the gifted learner is exposed to higher order

thinking skill where calculations involve various real-world applications of the calculating area.

2.7.1 Acceleration

Acceleration is regarded as a strategy where learners are allowed to enter and exit stages of development earlier than the traditional way (VanTassel-Baska, 2007). Many reports show that gifted learners of mathematics may progress rapidly on the contents of mathematics during acceleration even if they have difficulties in other areas such as creative writing or learning a second language (Davis & Rimm, 2004). The rapid movement or fast-tracking could mean that learners learn the same mathematical content at a pace that is faster than their peers (Koshy, 2013). However, VanTassel-Baska (2004) emphasizes on developing the conceptual knowledge rather than moving fast through the same learning content.

The strategy of acceleration can be done in different ways to allow gifted learners to work through the set curriculum at a faster pace than their classmates and avoid boredom caused by working with the content already learned (Manning, Stanford, & Reeves, 2010; Renzulli & Renzulli, 2010). Teachers in the regular classrooms may suggest that gifted learners within the class be given the opportunity to learn higher levels of mathematics, by providing the learners with more advanced subject material or curriculum than the normal curriculum. Sharing classes with higher grades also enable learners to practice mathematics with older pupils outside the classroom (Manning et al., 2010). For example, if a learner in a grade 10 regular classroom is excelling in mathematics, the classroom teachers may suggest that the learner be allowed to attend mathematics instruction in grade 11 classrooms. In addition to subject-acceleration, whole-grade acceleration can also be another option for gifted learners who have mastered grade-level content in all subjects' area (Renzulli & Renzulli, 2010). Grade skipping could mean that some promising learners can exit from school earlier (VanTassel-Baska, 2004) and proceed to colleges and universities.

The accelerated curricular pace is not challenging to the learner nor is the learner provided with any extra task. Gifted learners need quickened pacing as a result of

their ability to make connections faster than their classmates (Susan Winebrenner & Brulles, 2008). The learner is merely given an opportunity to accelerate through course material at a pace that matches their ability. The learner is positioned at a most suitable level of instruction. Therefore, acceleration is a reference to the gifted learner's improvement. The curriculum is not accelerated but is fine-tuned to accommodate the needs of the gifted learner (Poli, 2018). When accelerating a learner, the most important consideration is to meet the learner's emotional needs and avoiding social maladjustment (Manyowa & Ncube, 2013).

Several research studies documented the significance of acceleration as a strategy of provision, yet many teachers are reluctant to support acceleration for gifted learners for fear of social and emotional issues. In the study to determine the perception of primary school teachers and principals in South African schools regarding the inclusion of gifted learners, Oswald and de Villiers (2013) found during the interviews with teachers that some learners choose to underperform because they want to be socially accepted. One teacher mentioned a situation where a gifted learner would work slowly as to avoid leaving the slow working peers behind since the rule is to finish first before a learner can be allowed to go to the library or the computer room. Summaries of studies from Kulik (2004), Lubinski (2004) and Rogers (2004; 2009) highlight the significance of acceleration as an intervention. The evidence from their collective work shows that acceleration yields positive growth in academic achievement. On the contrary to the belief that accelerated11 learners regret the decision to be accelerated, Lubinski (2004) found out that gifted learners who experienced acceleration in high school did not regret the decision.

Misconceptions about acceleration strategies for gifted learners lead to underachievement, which worsen the problem, noting that when a gifted learner is held back by expecting them to perform with their grade level peers, the cost to the country and the whole nation is huge. Whenever a gifted learner underachieves, social capital is lost. In *A Nation Deceived* report, Colangelo, Assouline and Gross (2004) presented 12 reasons acceleration is still a problem to teachers and parents. Reasons for the lack of acceptance include the following: teachers fear that accelerated learners will have knowledge gaps, age, lack of knowledge on acceleration and how to properly put the intervention into effect. Basically, the

lowering of standards from excellence to baseline competence lowers national standards and ultimately demotivates gifted learners (Anderson, 2013). Research indicates that learners who are not challenged academically, develop emotional difficulties through inappropriate education settings (Guyton, 2013).

2.7.2 Differentiation

Identification of goals, outcomes and what is to be learned by the gifted at different stages have to be identified initially with curriculum differentiation. As supported by many researchers in education, VanTassel-Baska (2007) suggests a full set of curriculum differentiation across domains which support the social-emotional needs of the gifted learners. A differentiated curriculum should bring new experiences that are different from the norm and which are characterized by 'depth' and 'complexity'. Gifted learners with the ability to 'conceptualize abstractively' and think in-depth are challenged by such experiences. Both Tomlinson (2004) and VanTassel-Baska (2007) agree that the selection of appropriate learning material for the gifted learners should go beyond the single textbook. Referring to mathematics, Koshy and Casey (2005) suggest that it is not to the benefit of learners to do extra problems in their textbooks or given extension assignment of the work that they have already learned after completing their regular work. For this reason, Koshy and Casey (2005) and VanTassel-Baska (2007) agree that the work for gifted learners should be part of a carefully designed plan for mathematics enrichment.

Studies about how mathematically gifted learners could be supported found that challenging tasks have been needed for such learners' development (Whitlow-Malin, 2007). To illustrate this, Diezmann and Watters (2002) in their study to investigate the importance of challenging tasks on the learning of gifted learners in mathematics, the results showed that challenging activities gave learners opportunity to reveal gifted characteristics such as flexible thinking abilities and persistence to reach the goal.

Most researchers conclude that the success of differentiated curriculum lies on the differentiated instructions, flexible grouping and ongoing assessment (Aftab, 2016; Classrooms & Chiluiza, 2017; VanTassel-Baska, 2007). The participants in the

research conducted by Oswald and de Villiers (2013) also agree with Koshy and Casey (2005) that if differentiation is well implemented, it offered a viable option for gifted learners to be catered for in the regular classrooms.

2.7.3 Enrichment

Enrichment in mathematics means expanding the learner's knowledge where mathematically gifted learners get the opportunity to learn mathematics in more depth (Koshy, 2013) independently from the strategies that may be in use.
As suggested by Koshy, Ernest and Casey (2009) enrichment is an alternative strategy to acceleration and differentiation. To meet the needs of mathematically gifted learners, teachers use differentiation to enrich and make activities challenging (Koshy et al., 2009). On the other side, teachers use acceleration when learners are motivated by a successful enrichment strategy so that they can solve more complex activities since gifted learners gain advanced knowledge when they practice their regular work (Casey, 2011).

Renzulli and Renzulli (2010) view enrichment teaching and learning as the roots in the theories, philosophies and study of Jerome Bruner, Jean Piaget and John Dewey, illustrating their concept in four basic principles based in cognitive development and educational reform. The principles recognize each learner as unique, therefore learning experiences need to involve individual interest, learning styles and abilities. Learning is effective when learners appreciate what they are being taught and is more enjoyable and relevant when content is understood in context. It follows then that enrichment learning and teaching can enhance task-commitment, motivation for learning, problem solving skills and most importantly can lead to total school improvement.

Gagné (2011) regards enrichment programmes to be the useful means for the development of gifted ability. Gagné (2011) states that the curriculum must be enriched to meet the pace of gifted learners. Gagné's study has demonstrated that gifted learners learn at different rates than average learners. According to Gagné, an enriched curriculum is essential to offer exceptional learners with daily challenges. Allowing gifted learners in mathematics classrooms to go through

greater challenges than their peers is necessary given that Gagné and St. Pere (2001) found that gifted learners display high levels of perseverance.

However, despite having such awareness of enrichment intentions, the success of enrichment programs for gifted learners still remains an area of great concern for teachers and policymakers (Reis & Renzulli, 2010).

2.7.4 Grouping learners

Grouping learners in classrooms have been recognized in South Africa and elsewhere as an organizational structure that helps teachers to offer the appropriate instructions within the curriculum to the diverse needs of every learner, especially those that are gifted (Gallagher, Smith, & Merrotsy, 2011; Hiebel, 2015; VanTassel-Baska, 2007). Grouping refers to the careful selection and sorting learners based on ability or performance. Grouping can be during certain periods in a school day or it can be for the whole school day depending on the purpose of the grouping (Slavin, 1987). The questions of whether, when and how to group learners frustrate most teachers as learners come from a wide variety of social backgrounds with different levels of knowledge, motivation and learning pace (Adams, 2002). Realization of all these differences compels teachers to look out for different teaching methods so that all learners are catered for. Although there are arguments about the ways of grouping gifted learners in the regular classrooms, it is uncommon for a high school teacher in South Africa and internationally to group learners in mathematics classrooms.

On one hand, some researchers such as (Lu, 2012), Mann (2006) and (Shield, 1996) are in favour of mixed-ability grouping. The above-mentioned sources contend that mixed-ability grouping caters all learners in the regular classrooms irrespective of race, intellectual abilities, and educational needs.

On the other hand, numerous studies pull from different ethical arguments in support of ability grouping. Tieso (2003) reviewed literature covering the years that goes back from 2003 to 1916 of best practices on instructional curricular for gifted

learners. Through the analysis of the studies, Tieso suggests that ability grouping together with curricular revision could produce considerable achievement for both average and gifted learners.

Slavin (1986) also carried a report on the effects of between- and within-class ability grouping on the achievement of learners. The analysis of Slavin's study covered findings from 14 researches of between-class grouping in multiple courses, 7 researches of between-class grouping in a single course and 8 researches of within class grouping. Thou the results did not support full-day ability grouping into different classrooms, they did support within-class ability grouping. Ability grouping in mathematics was also found instructionally effective. Slavin concluded that ability grouping is in the best way when it is limited to 1 or 2 subjects within the regular classrooms.

Despite the trend of grouping learners by ability in regular classrooms, some of the concerns expressed by Gagné (2007) are still at the forefront of those against ability grouping. In his ninth Commandment of Academic Talent Development (Though Shalt Group…Fulltimely!), he stated that the commandment enjoins all teachers to aim at grouping gifted learners at full-time basis. Gagné (2007) claimed that gifted learners are underserved in regular classrooms because there is a problem of priorities; the Number 1 priority is to increase the pass rate so that learners can move to the next grade level. Gagné pointed that apart from the problem of population size, teachers regularly complain about not given enough resources to teach gifted learners.

Ability grouping

Ability grouping is a practice in which gifted and average learners are separated into groups for instruction. In ability grouping, teachers can assign learners to different classrooms so that learners who function similarly in learning achievement and capacity are placed together for instruction. It is noticeable that in both strategies the underlying expectation is that learners will be grouped in an appropriate developmental environment. The method of ability grouping allows teachers to move the learners between groups as necessitated by their demonstrated competences.

The practice of ability grouping is achieved basing upon learners' performance in tests and subjective evaluation by teachers on learners' competences (Mafa, 2009).

The practice of changing classrooms for only one or two subjects is also referred to as ability grouping or sorting (Collins & Gan, 2013). In this situation, the groups are not fixed throughout the day. Because of preparations, learners that are ability grouped across heterogeneously grouped classes for more than one subject can end up being tracked, which often occurs in middle and high schools. These strategies of merit-based selection utilise criteria to group learners in a prescribed course that does not always play out consistently in terms of socio-economic status (Holdgreve-Resendez, Youngs, & Qian, 2009; Stinnett, 2013)). Delmore (2005) describe ability grouping as special classrooms for gifted learners while other learners are grouped heterogeneously.

The two most common practices of ability grouping are to group learners within – class and between-class. Within-class grouping requires a teacher to create small groups of learners according to their ability usually for mathematical instruction. While teachers in within-class teach one ability subgroup a new concept, for example, other ability level subgroups work on their own. The teacher attends to different abilities separately. After attending to all subgroups, the teacher may have some time to discuss the same new work with the rest of the class.

Between-class ability grouping is used to separate learners into their chosen subjects, courses or course sequence based on their academic performance (SO & Agbayewa, 2011). In this grouping method, learners in a grade are stratified, commonly into two or three levels of skills, such as low, medium and high. Between-class ability grouping method in mathematics is achieved by taking prior achievement in mathematics or by using some overall rating by the teacher or school. There is minor adjustment of the curriculum to the ability level of the learners in different classes. Gentry and MacDougall (2008) indicate that while each class is taught the same curriculum, the higher-level classes are taught at a greater depth than the low-level classes.

Gentry and MacDougall (2008) acknowledge another variation of between-class ability grouping. The method is used by many high schools to group learners according to their perceived ability or achievement. The strategy used in the variation is referred to as grouping by curriculum and commonly known as tracking or streaming. Learners are placed in low, middle or high tracks with the aim of providing them with a level of curriculum that is appropriate to their needs. Instead of just using variations in the depth of instruction in the same curriculum, this approach offers different curricula for learners in different tracks. Successful learners are assigned to high-level tracks while struggling learners are sent low-level tracks, with the intention that all learners can perform according to their ability. Learners can also move up and down the ladder depending on their achievement. Streaming also makes teaching easier as teachers can concentrate only on one level of instruction.

The practice of ability grouping allows teachers to tailor the pace and instructional content according to the needs of learners, thus improving learners' achievement (Schofield, 2010). For example, teachers can provide low archived learners with needed repetition and reinforcement whereas high achievers can be provided with an advanced level of instructions. It is within high-ability grouping that the research suggests sustainable academic achievements (Matthews, Ritchotte, & McBee, 2013). The low-ability learners benefit from a slower pace and teacher directed activities when the gifted learners get more challenging tasks at a faster pace. This contributes significantly to the development of gifted learners. Even though grouping gifted learners together enhances higher attainment, it has also been proven that when the learners are placed in mixed-ability classes, the level of attainment of the most able learners was unaffected by the change (Ireson & Hallam, 2001).

Mixed-Ability grouping

Mixed-ability grouping is the strategy of grouping learners with varied abilities into learning groups so that there are heterogenous groups within the classroom. In mixed-ability groups, teachers reported that learners of all abilities are taught the same way, work on the same activities and have the same access to the curriculum. Teachers in mixed ability classes offer a variety of activities, whereas they tended

to use more whole class instruction with sets. Teaching a large and mixed-ability groups class with learners who differ in terms of learning, creates problems for the learners and teachers themselves. Different learners have different interests which can be difficult for the teacher to provide in terms of topics and materials. Learners may find themselves not motivated and not provided well attention from teachers likewise the appropriate feedback. Such an environment of uncontrolled freedom can cause serious problems for the learners resulting from the absence of discipline in the classroom.

Research has dealt with how teachers can use mixed-ability grouping (Bailey & Bridges, 2016; Lu, 2012; Watkins, 2014). However, in actual teaching situations there is concern on how to cater for the different ability levels. Teachers are not trained or given workshops on how to thoroughly prepare for appropriate adaptation according to learners' needs. Different mathematics teachers' guide, for example do not guide teachers in differentiating the materials in order to cope with learners in mixed-ability classes. It is common for teachers to try to deal with the situation through teaching the average, leaving the slow learners to struggle and failing to meet the needs of gifted learners at the same time.

Studies revealed that mixed-ability grouping promote the learning of the slow learners (Ireson & Hallam, 2001; Venkatakrishnan & Wiliam, 2003). Venkatakrishnan and William (2003) examined achievements of mathematics' learners who were placed in different types of groups in an English comprehensive school. The study revealed that gifted learners did not benefit from the mixed-ability grouping, but the slower learners showed significant improvements in mixed ability grouping. Ireson and Hallam (2001) also argue that the mixed-ability grouping tends to advance slow learners at the expense of gifted learners.

Recommendations for other grouping strategies that meet the needs of gifted learners in regular classrooms have been around for a while, but teachers follow hard on the heels of demands for full inclusion in the general education program, mixed-ability grouping and the contradictions of the curriculum that followed standard-based reforms like No Child Left Behind (Brigham & Brigham, 2010). The political climate of schools over the past has created a situation in which teachers,

parents and leaders assume that learners should never be separated for instructional grouping. Recommendations to group learners according to their ability are likely to be criticised.

Cluster grouping

Cluster grouping is a programming option designed to group learners into clusters in a heterogeneous classroom setting so that they may receive differentiated instruction. The key trend is to meet social, emotional and intellectual needs of the gifted learners, with differentiated and opportunity to learn with their intellectual and their mixed ability peers (Biddick, 2009; Poli, 2018). Though the strategy of cluster grouping has the potential to allow learners to work together while being offered opportunity to work on challenging mathematics tasks, grouping alone has very little or no impact on academic achievements. Teachers must group learners and differentiate with acceleration tasks. This allows gifted learners to grow independently and share cooperatively with likeminded learners (Poli, 2018).

Brulles and Winebrenner (2011) reports that learners in flexible groupings are prepared for more challenging activities and share similar learning preferences. Grouping of learners should change based on the targeted goals and content. Rogers (1991), supported by the National Research Center on the Gifted and Talented, reviewed grouping strategies in 13 studies on the effects of grouping for acceleration, ability grouping, mixed ability grouping and cooperative grouping. Rogers showed that when gifted learners were in cluster grouping with the differentiated curriculum, the learners' achievement improved. The meta- analytic study of Kulik and Kulik (1992) revealed that the effects of different grouping strategies depend on their features. Strategies that involve only minor modifications of course content for gifted learners usually have little or no effect on learner learning. Acceleration and enrichment strategies have the largest effects on learner achievement with gifted learners in accelerated classrooms performing more than nonaccelerated peers. Both Roger's (1991) and Kulik and Kulik's (1992) studies strongly support cluster grouping strategies.

Cluster grouping has been used in regular mathematics classrooms to teach gifted learners for decades and is receiving attention as a program option (Gentry & MacDougall, 2008). Benefits of cluster grouping include identification of gifted learners, inclusionary setting and delivering instruction suitable for the wide range of learners in the classroom (Brulles & Winebrenner, 2011). The strategy of cluster grouping allows teachers in mathematics classrooms to know and accept the inherent needs of their gifted learners. Teachers are more likely to compact the content and practice acceleration when learners are cluster grouped (Brulles & Winebrenner, 2011). Gifted learners are identified and receive services during cluster grouping on a daily basis with few financial implications to the schools. In a gifted cluster model, identified learners get services irrespective of their ability level and achievement level. Experts in gifted education often recommend a specific number of high achieving learners, for example, three to ten learners to make up the cluster while the rest of the class remain heterogeneous. Though cluster grouping places the highest achieving learners together in a classroom, it affects all learners. As a result, cluster grouping need not to seen as a program for only gifted learners, but also as a total school program.

Conflicting opinions and conclusions continue concerning cluster grouping. Cluster grouping has been proclaimed as both a successful means for promoting learner achievement prior democratic government in South Africa. During those times, teachers were doing their best to meet learners' individual needs within their classrooms. With the current and emotional calls for the introduction of full inclusion, increased classroom sizes and increased accountability for learner-performance, teachers have found meeting the needs of every learner in the regular classroom nearly impossible (Oswald & de Villiers, 2013). But still, most researchers agree that the strategy of cluster grouping will avoid the problem of schools by trying to mix average learners with gifted learners for the sake of grouping convenience. When teachers align their instruction to the skill level of the learner, learners of all levels benefit, and this is the method to achievement grouping that cluster grouping embraces (Mann, 2008).

2.7.5 Mathematics Portfolios

One popular strategy that teachers use to document the performance of learners is through portfolios. A learner's portfolio - which was later reviewed in 2009 by the then Minister of Basic Education (Department of Basic Education, 2011) gives an opportunity to reflect on the learner's growth in terms of problem-solving activities, projects, and creative productions. The growth of mathematics portfolio is linked to the National Department of Education in recording learner's performance on the knowledge, skills, and values embedded in the assessment standards. The mathematics portfolio requires learners to be mathematical problem solvers, learn how to communicate and reason mathematically, and develop confidence in mathematics.

During the study in *Teaching Thinking in Primary Schools through Mathematics,* Dimitriadis (2005) experienced the successful use of portfolios. The results of the study revealed that the learners were motivated to work harder when they saw their good work in their portfolio of evidence. In the similar study conducted by Burks (2010), most learners believe there is a benefit in maintaining mathematics portfolios. Despite the lack of a statistical difference between the portfolio groups and non-portfolio groups, Burks (2010) found a significance correlation between an organized and complete portfolio and increase performance in learner's assessment. In addition, Koshy, Ernest & Casey (2009) in their *Mathematics Enrichment Project* in Brunel University, offered a guidance to both teachers and learners on how to develop a portfolio for mathematically gifted learners.

2.7.6 Mathematics Competitions

Mathematics competitions play an important role in the educational provision for gifted learners (Renzulli, 1994). The main goals of mathematics competitions are to motivate learners, increase attitude towards mathematics, and to provide teachers and parents with information about gifted learners (Bicknell & Riley, 2012). Although motivating for the gifted learners, activities can be designed at various levels to allow average learners to get exposure to a number of positive benefits of mathematics competitions.

Mathematics competitions are also viewed as an important part of the multiple method of identification process of gifted learners. They provide learners with opportunity to compete themselves with others and also strive for their personal development. This view was supported by Kenderov (2006) who also argues that competitions provide a tool to identify and develop gifted learners who do not experience any challenge in the standard curriculum and their mathematical abilities and talent remain unnoticed and undeveloped. Gifted learners need challenging mathematics competitions to maintain their concentration on mathematics and prevent them from moving to practices outside mathematics they may find interesting. Instead of paying more attention to a small group of winners, participation in mathematics competition is crucial since the preparation for the competition itself, and solving mathematical problems during the competition enhances the experience of all participants. Moreover, it has been found that the learning of routine material is also enhanced when occurring in a challenging environment (Barbeau & Taylor, 2009).

In South African high schools, there is a range of local, provincial, national and international opportunities for learners to compete against others' mathematical abilities in assessments, projects, and problem-solving events. The South African Maths Olympiad (SAMO) for grades 8 to 12 learners is the biggest Olympiad in the country where almost 100 000 learners participated in 2017. The first round is written in March and learners who obtained 50% or higher move to the second round which is written in May. The best 100 junior and senior learners from the previous round qualify for the final round (third round). The emphasis of the competition is that mathematics is about thinking, discovery, and validation of problem-solving methods.

2.7.7 Teachers' attitude towards gifted learners

The attitude of teachers is important because it can affect gifted education in various ways, as teachers implement the educational practices necessary to ensure gifted learners are appropriately challenged in their classrooms. Teachers could also contribute in the future of gifted learners by either enhancing or impeding the

development of gifted learners' potential (Clark 2002; Geake & Gross 2008). Researchers in the field of gifted education have been studying the attitudes of teachers towards gifted learners (Garni & Abdullah, 2012; Molapo & Salyers, 2014; Perković Krijan, Jurčec, & Borić, 2015) without any clear positive or negative findings emerging as a whole. Some studies indicated teachers generally had positive attitudes and are highly supportive and believe that all learners need support to reach their full potential. Other studies suggested that teachers held overall slightly positive attitudes towards gifted learners, however, the participants were resistant to offering special services to gifted learners within the regular classroom (Garni & Abdullah, 2012). On the other hand, there are findings which showed teachers harboured negative attitudes in general (Geake & Gross, 2008) with participants who are indifferent or do not know about the needs of gifted learners, while other findings showed mixed results, with both positive and negative attitudes towards gifted learners (Megay-Nespoli, 2001).

Jacobs's (1972) study on teacher attitude toward gifted children showed negative or limiting attitudes to those of high school dropouts. One reason for those negative attitudes was mentioned by Peachman (1942) regarding heightened myths and misconceptions held about gifted learners. This myths and misconceptions may result in the belief that gifted learners do not need priority in additional services. Another reason presented is the shortage for differentiation within regular classrooms (Oswald & de Villiers, 2013; Tomlinson, 1994) which leads to frustration to teachers and boredom to learners (Laschober, 2012).

In Chipego's (2004) research, the attitudes of Pennsylavania elementary classroom teachers toward gifted education were examined. The results showed that the teachers had slight positive attitude toward special services for gifted learners and the acceptance of gifted learners in the classrooms. However, the attitudes of teachers toward ability grouping were negative. The lack of support for ability grouping and acceleration were also found in the study of Lassig (2015) which explored the attitudes of primary school teachers towards gifted learners and their education at eight schools. The results of Lassig's (2015a) suggest that further development and the involvement of the whole school in gifted education may help in improving teachers' attitudes towards gifted learners and their education.

2.8 Support for teachers of mathematically gifted learners

Regular classroom teachers often do not have the necessary skills, knowledge and confidence to identify and meet the needs of gifted learners. Research indicates that this shortage of readiness may be related to teachers' professional development (Fraser-Seeto, Howard, & Woodcock, 2015). A patchwork system of teacher training, provision of programs and the inadequate accountability has real implications for gifted learners who may possibly not do well without rigorous instruction (National Association for Gifted Children, 2010).

Reid (2010) states that for a regular classroom to accommodate the needs of all learners, educational setting requires planning, trained teachers, and other support. Regular classrooms and the elevated expectations of individual learners have a profound impact on pre-service teacher preparation (Harvey, Yssel, Bauserman, & Merbler, 2010; Saqr & Tennant, 2016).

The impact of training program on teacher perception and expectations of learners affect classroom interactions. Rizza and Morrison (2003) discovered that teachers having additional training were actually able to identify qualities of gifted learners more effectively than those without training. The study conducted by Geake and Gross (2008) on teachers' attitude towards academically gifted students found that specific professional development for teacher on the academic characteristics of gifted learners had a significant effect on attitudes regarding gifted learners. Geake and Gross (2008) concluded that responses to survey questions by teachers without training indicated a negative attitude towards gifted learners.

Most certainly, teachers who received a proper training will be one of the requirements for a success in meeting the needs of gifted education (Blanchfield & Browne, 2013). Similar view concerning the importance of teacher training is also found in the study of Oswald and de Villiers (2013) as it is suggested there is a need in developing more teachers in South Africa in the area of gifted education, and yet, properly retraining them in order to accomplish the global primary education target (Blanchfield & Browne, 2013). Therefore, it is very necessary for teacher to be

equipped with extensive skills, techniques and strategies needed to efficiently promote individual learning as well as development of each learner under different conditions (Carrington & Macarthur, 2012).

CHAPTER 3: RESEARCH METHODOLOGY AND DESIGN

3.1 Introduction

The previous chapter helped place the researcher in an academic context. This chapter offers a rationale for the methods used in relation to the research questions about the identification of gifted learners and support for them from mathematics teachers in Bloemfontein high schools. There follows a discussion regarding sampling and data collection. Subsequent discussion centers on the development of research instruments, pilot work and approaches to data analysis of the research data

3.2 Design

The current study used the mixed methodology in order to get more comprehensive view whilst ensuring triangulation. Johnson, Onwuegbuzie, and Turner (2016) describe mixed methods research as "*the class of research where the researcher combines or mixes qualitative method and quantitative method research techniques, concepts, approaches or languages into a single study*". Taking into account the purpose of the research which was to investigate strategies which teachers use when they support mathematically gifted learners in their inclusive classrooms, and the following research questions: i) How can teachers identify a gifted learner in mathematics, ii) What strategies are suitable for supporting mathematically gifted learners? And iii) to what extent are teachers' strategies meeting the needs of the gifted learners? The researcher decided to involve both quantitative and qualitative methods for data collection as suggested by Creswell (2013).

The use of mixed methods research occurs mostly in educational studies. Creswell (2013) considers the use of both quantitative and qualitative research as the best strategy which has the most to offer. According to Johnson and Onwuegbuzie (2004), the aim of mixed methods research is not to substitute either quantitative or

qualitative approaches, but to minimize possible weaknesses in the study. Mixed methodology adds breadth and richness to research Brannen (2005).

Creswell and Creswell (2017) state that there are two advantages of using mixed methods research. The first advantage is that different methods can be employed in a study and this would give the researcher confidence as the most important issues would be dealt with. Secondly, the multi-methods approach allows triangulation to occur. Additionally, Onwuegbuzie and Leech (2005) share the belief of advocates of mixed method research and argue convincingly that a combination of methods strengthens the overall conclusion.

The mixed methods research is not without difficulties. The researcher has to be familiar with the relevant methods. Data collection and data analysis may become more complex and take longer than expected. Therefore, when planning the study, the researcher needs to clarify the aim of mixed methods research and its applications. Procedures then involve the data collection and data analysis approaches and the researcher's role in the study (Creswell, 2013). So, in this study, the teachers involved had questionnaires carried out in an independent manner - this shows the quantitative part of the study. Teachers also participated in face to face interviews where the researcher positioned himself as a neutral investigator, and this reflected the qualitative feature of the study.

3.3 Data Collection Techniques

The main methods of data collection were questionnaires followed by the recording of interviews. Structured questionnaires and a semi-structured interview in mixed method studies allow the researcher to generate confirmatory results regardless of differences in data collection methods (Harris & Brown, 2010). Quantitative questionnaires provide evidence of patterns amongst the population and qualitative interviews often gather more information on participants' actions, thoughts, and attitudes.

3.3.1 Questionnaire

A questionnaire offers a quantitative or numeric description of trends and opinions of a population by studying a sample of that population (Creswell, 2013). Using questionnaires is suitable for a study that requires several types of information (Wray & Bloomer, 2013). The 20 grade ten mathematics teachers were given the same questionnaire (Appendix A) after agreeing to take part in the study. Only 19 teachers returned the questionnaires.

The questionnaire consisted of twenty-three questions which were formulated to extract four types of information from the participants. The first type of information is biographic information. Participants gave some background of biographic information which includes their gender, age, number of years in the teaching profession, the level of education and special education workshop or courses provided by the Department of Education. The second type of information deals with the identification of mathematically gifted learners. Participants were asked about different methods they use to identify gifted learners and also to evaluate the process of identification. The third type of information to be gained by the researcher is related to the support that teachers offer to their gifted learners in mathematics classrooms. The fourth type of information is about participants as teachers of mathematically gifted learners. The researcher wanted to get information on how comfortable the participants in teaching mathematics to the gifted learners are and how well are the needs of such learners addressed in their schools.

3.3.2 Interviews

Interviews give participants the opportunity to express themselves about the conditions and situations of their work environment (Schultze & Avital, 2011). Therefore, face- to-face semi-structured interviews are seen in this study as the best tool for two people to exchange views on a subject of shared interest. Interviews were conducted to get thorough information about the strategies used by teachers to identify and support gifted learners in mathematics. The interviews were depended on the participant's consent. During the face-to-face interviews, a tape recorder was used to record the exact words of the participants.

Semi-structured interviews using open-ended questions were employed in the study wherein the researcher asked a pre-determined set of questions using the same wording and order of questions. The interview guide (appendix B) was not presented to the interviewees. The technique of open-ended interviews involves questions whose subject and sequence have not been completely identified before the interview. This type of interview has the advantage of being objective while permitting a more thorough and clearer understanding of the participants' opinions. Another advantage of employing this technique is that it allows flexibility in the subject and the sequence, according to each individual respondent. The open-ended questions allowed the researcher to rephrase questions when responses sounded unclear.

McMillan and Schumacher (2014) define in-depth interviews as a conversation with a goal. To make proper arrangements for the interviews, the researcher visited the schools and explained the purpose of the study prior to the conducting of the interview. Participants were interviewed for about thirty minutes. There were ten interviews and were tape-recorded with the full permission of participants, to ensure that the important information was not omitted. The interviews were conducted in venues and at times (which was during working hours) suggested by the teachers.

3.4 Population

A population is the group to which a researcher would like the results of a study to be generalized (Banerjee & Chaudhury, 2010). Moreover, the intended population should be carefully defined. The population that was used in this study was teachers teaching mathematics in grade ten high schools around Bloemfontein.

3.5 Sample Techniques

Sampling refers to the process of selecting a subset of persons or things from a defined population, also known as a sampling frame (Scott & Morrison, 2005), with the intent that the sample accurately represents that population (DePoy & Gitlin, 2015). A non-probability sampling procedure (Etikan, Musa, & Alkassim, 2016) was

employed for the selection of knowledgeable participants. For this reason, a purposive sampling method was used to select teachers in grade 10 mathematics classrooms in high schools around Bloemfontein.

The decision of using a purposive sampling was made in view of the fact that some schools might not be offering mathematics to their learners. Hence, there would be no point doing a random sampling of the schools. For this study, ten high schools in Motheo District were targeted. Purposeful sampling aids in obtaining the richest information from the participants (Palinkas et al., 2015). Creswell (2014) further reports that purposeful sampling is used to understand the central phenomenon of the research. The targeted sample was twenty teachers.

3.6 Reliability and Validity

3.6.1 Reliability

Reliability relates to consistency and dependability in measurement with time, whether the study is representative of the population (Cohen, Manion, & Morrison, 2011), and whether the study can possibly be reproduced. In order to maintain reliability, the researcher tested the questionnaire with four teacher colleagues. The researcher also administered the same type of questionnaire to all the respondents, that is, all teachers who participated in the study were given the same type of questions with the same type of wording. The researcher assumes all the participants will have the same interpretation of the questions which were constructed in English so as to be easily understood by all respondents. The interviews were audio-recorded and also transcribed verbatim to help with reliability. In order to further increase the study's reliability, the researcher sustained careful record keeping questionnaire documents and digital recordings, interviews and transcription to accurately record the data analysis process.

3.6.2 Validity

Data validity is necessary when using quantitative and qualitative methods in research. To enhance the validity of analysis data and results, the researcher strived to gather data by using a number of sources such as questionnaires and interviews. Gathering information through a wide range of sources and a variety of techniques helps to confirm results. If the same findings are obtained in the study, the researcher can become certain that the data are valid. The epistemological and ontological expectations supporting various research paradigms have an effect on methodological considerations and as a result the methods and instruments chosen and used to collect data (de Gialdino, 2009). In mixed method research, validity can be dealt with during various stages of the research process. Teddlie and Tashakkori (2009) explained validity at the time of the design and interpretation phases of research by dealing with fidelity and rigor of the methods along with the analytic interpretation of data. Onwuegbuzie and Leech (2005) expressed the need of some researchers to put a lot more emphasis on validity concerning the real data analysis stage of research. Creswell (2013) asserted that the idea of validity is involved in all aspects of the research process from data collection, to analysis, interpretation, and the analytic methods used in combining data sets for analysis. To minimise validity concerns in data collection and analysis, the researcher was as transparent as possible. Throughout the research processes the researcher worked closely with the supervisor of the study, so as to ensure that the study compiled with stringent processes and analyses (Mitchell, 2014).

3.7 Triangulation

This study used methodological triangulation which mixes quantitative and qualitative, and data triangulation which use more than one approach of data collection (questionnaires and interviews). Through triangulation, quantitative and qualitative data can be collected to substantiate the results (Zohrabi, 2013). The term triangulation seems to have been subject to several renderings and explanations. The concept of triangulation was initially connected to quantitative research through which more than one data collecting method would be used to offer a lot more confidence in research results. Triangulation is more than just

aggregation of various data types to provide a much better picture compared to what one source alone would give. Triangulation should also be considered as cross-checking procedure. This broader view of triangulation implies that when it comes to qualitative research there may be several observers, theoretical perspectives and source of methodologies and data. The use of triangulation in mixed method study, is one way of improving the validity of the study and is supported by education methodologist (Atkinson & Delamont, 2005; Cohen et al., 2011; Denzin & Lincoln, 2011).

3.8 Data Analysis

Responses to the questionnaires were analysed using descriptive statistics of frequencies and percentages. The data collected from the interviews with the teachers in this study were thematically analyzed. This involved categorizing the data by keeping in mind the research questions, what has gathered through the literature review and the themes that emerged during the field work. Thematic Analysis (TA) is a method used to analyze patterns of meanings in the collected dataset (Thomas & Harden, 2008). It helps in understanding which of the themes best describe the phenomenon under investigation.

The responses of the teachers were recorded on the audio recorder with their permission and listened several times so as to give up the maximum information. The analysis of the interviews began with several readings of the transcribed interview data and focusing on the responses that were relevant to the research questions. Teacher's responses for all the questions were presented in a tabular form, that is, a table for each of the 13 questions. The responses to the questions were not rephrased but were presented verbatim (exactly the way teachers answered the questions). The responses of the teachers per question were grouped together to make a common pattern. For example, four teachers responded the same way to a question, forming a pattern, which then created the third column as is in the example below:

Do you feel that gifted learners should be given the same or challenging activities than their classmates?

Table 3.1: Teachers' responses

Teacher	Response	Pattern
Teacher 4	"If you don't give them more challenging work, they will finish early, and they will disrupt the class. Give them extra work and improve their quality as well."	Gifted learners should be given challenging activities than their classmates
Teacher 1	"I think if they were given more challenging activities it would anyway improve their mathematical skills. If it was possible they would receive a different assessment from those who are average and those who are struggling."	
Teacher 2	"I think they should be given more challenging than other students."	
Teacher 9	"Yes. Everything to them is easy so those learners have to be challenged.	
Teacher 7	"I don't think it's fair. I think it is much fair when learners are gifted and yes, it is, but I think it's not fair for them to get more challenging questions."	Gifted learners should be given the same activities with their classmates
Teacher 10	"I think that it will be a problem to give them more challenging activities because I think it will discourage others, the slow learners they will think others are better than them, so they must be given the same."	

Afterward the patterns were organized into a categorised table with two columns, one being the patterns from the three-column table and the other being categories from the patterns. There were 12 categories as in the example below:

Table 3.2: Categories in the data

Patterns	Categories
Gifted learners should be given challenging activities than their classmates	Differentiation
Gifted learners should be given the same activities with their classmates	
AMET	Enrichment
Computers	
IPP	
Videos	
Teachers need to be supported by technology based-materials	Teachers need support
Teachers need more workshops, training and help one another to teach gifted learners	

The twelve categories were condensed to 4 themes by grouping similar categories and deciding on those that were most relevant to the research question as in the example below:

Themes that emerged from the categories

Table 3.3: Themes that emerged from categories

Categories	Themes
Differentiation	Supporting mathematically gifted learners
Enrichment	
Teachers need support	Supporting teachers of gifted learners

Because the interviews were based on a series of questions, the emerging themes from the interviews were compared to the literature and analyzed according to the research question.

Denscombe (2014) suggested few guidelines for qualitative data analysis. Denscombe asserts that by adopting them will probably lead to more sufficient results. The first guideline is to compact extensive and diverse raw data into a condensed structure which could be achieved by organising written data into tables or charts. The second guideline is to clearly relate the research objectives and summary. Alhojailan (2012) noted that this principle mostly fit when the objectives

of the research considered the clear drivers responsible for its study and analytical methodologies. The third guideline proposes that the researcher should conclude by improving the conceptual basis or by developing a model of the study.

CHAPTER 4: RESULTS ANALYSIS

4.1 Introduction

Chapter 4 of this thesis reports the results from the questionnaire survey collected from the respondents and the interviews conducted. Grade 10 mathematics teachers from ten high schools around Bloemfontein responded to the questionnaires. Nineteen (19) out of twenty (20) questionnaires were returned. Interviews were conducted with 11 teachers. The first section of this chapter describes the biographic information of the respondents involved in the study. The second section of the chapter concentrates upon how teachers identify gifted learners in mathematics classrooms. In the third discussion, the chapter turns to the strategies used by the teachers to support mathematically gifted learners. The chapter concludes with data (section 4) on self-reflection by respondents in the survey as teachers of mathematically gifted learners.

4.2 The questionnaire

4.2.1 Section 1: Biographical background

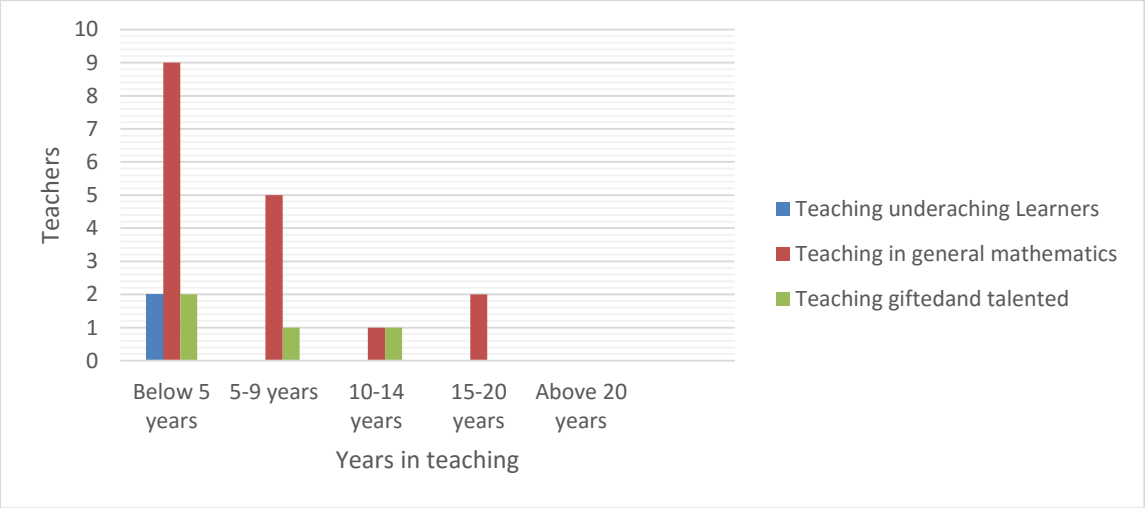


Figure 4. 1: Biographical information (n=19)

Table 4.1 indicates that the majority of educators, 17 (89.5%) received training in teaching mathematics in general. Only fewer respondents, 4 (21.5%) received training in teaching gifted and talented learners. Most of the respondents, 2 (10.5%) who received training in teaching the gifted and talented have also received training in teaching the less able or underachieving learners and have teaching experience

of below 5 years. Educators with the teaching experience of above 15 years did not receive a special training in teaching mathematics to the gifted and talented learners. Only two teachers did not give any information about the teaching training that they had attended.

The figures that relating to training indicate that many of the teachers teaching gifted learners were working without designed and progressive preparation. Therefore, the training programme undergone by most of the teachers was insufficient and failed to prepare teachers to cater for the needs of gifted learners.

4.2.2 Section 2: About identifying mathematically gifted learners

'Do you have gifted learners in your mathematics classroom?'

Table 4. 1: Gifted learners in mathematics classrooms (n=19)

Answer	Frequency	Percentage
Yes	18	94.7
No	1	5.3
Not sure	0	0
TOTAL	19	100

Teachers were first asked if they had gifted learners in their mathematics classrooms. Almost all of them (95%) indicated that they had learners whom they view as gifted in their regular classrooms. Only one teacher out of nineteen teachers cited (5%) claimed not having gifted learners in the teacher's regular classroom.

'Does your school have the policy to identify and develop gifted and talented learners?'

Table 4. 2: School policy to identify and develop gifted and talented learners (n=19)

Answer	Frequency	Percentage
Yes	6	31.6
No	9	47.4
Not sure	4	21.1
TOTAL	19	100

Table 4.2 shows that 47% of respondent did not have a policy to identify and develop gifted and talented learners in their schools. A further 31% suggested that these policies exist in those schools and just fewer than 21% felt that they were not sure. These results show that most of the schools in the area do not have the policy to identify and develop gifted and talented learners.

'Do you have a separate register in your school or classroom for mathematically gifted learners?'

Table 4. 3: School or classroom register for mathematically gifted learners (n=19)

Answer	Frequency	Percentage
Yes	2	10.5
No	15	79
Not sure	2	10.5
TOTAL	19	100

The above table shows that the majority of teachers, 15 (79%) do not have a separate register in their schools or classrooms for mathematically gifted learners. Two (10.5%) responders indicated that there is a separate register for the mathematically gifted learners. Another two (10.5%) felt that they could not comment on one way or another on the issue of a separate register in their schools

or classrooms. It is not immediately clear how over 10% revealed by participants keep records of separate registers.

'Which method do you use to identify gifted learners in your mathematics classroom?'

Table 4. 4: Methods by teachers to identify gifted learners (n=19)

Method	Yes		No		Not sure		Total	
	Frequency	%	Frequency	%	Frequency	%	Frequency	%
Nomination	13	68.4	5	26.3	1	5.3	19	100
Assessment results	16	84.2	2	10.5	1	5.3	19	100
Identification by other teacher or previous school	2	10.5	12	63.2	5	26.3	19	100
Identification by parents	2	10.5	14	73.7	3	15.8	19	100
Other methods	2	10.5	12	63.2	5	10.5	19	100

Results show that the most widely used method by the teachers to identify gifted learners in mathematics classrooms centered upon nomination and assessment results. About 84% of the participants cited assessment results and approximately 68% mentioned nomination as observing the learner's performance during question and answer sessions. A smaller proportion just above 10% cited identification by other teacher or previous school, identification by parents and other methods.

'How would you evaluate the identification process of mathematically gifted learners in your classroom?'

Table 4. 5: Level of the identification process (n=19)

Level of the identification process	Frequency	Percentage
Easy	6	31.6
Very easy	1	5.3
Neither easy nor difficult	9	47.4
Difficult	3	15.8
Very difficult	0	0
TOTAL	**19**	**100**

From table 4.5 it is clear that a large number of the respondents (47.4%) were not sure about how a gifted learner can be identified. A further 31.6% indicated that the process was easy, but just over 15% mentioned that it was difficult. Only less than 6% indicated that the process was very easy and none of the respondents chose "neither easy nor difficult".

4.2.3 Section 3: About supporting mathematically gifted learners

'Do your learners in the classroom have a preference for individual or group work?'

Table 4. 6: Learners' preference for individual or group work (n=19)

Answer	Frequency	Percentage
Yes	10	52.6
No	9	47.4
Total	**19**	**100**

This table shows 47.4% of teachers indicated that learners do not have a preference for individual or group work. Only 52.6% of the respondents agreed that learners have a first choice in terms of individual or group work.

'How do you group learners in your classroom?'

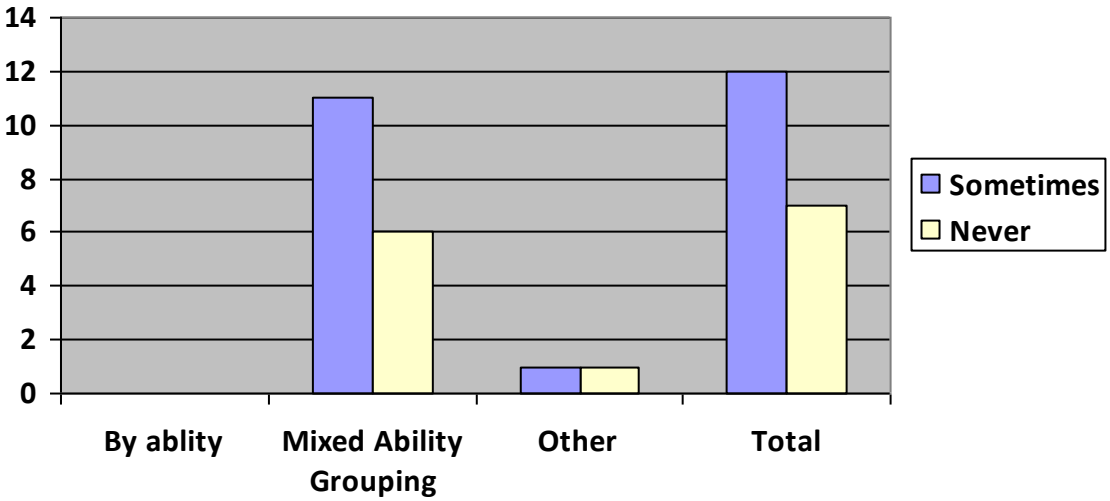


Figure 4. 2: Grouping strategies for the learners

Results suggest that the most favored practice to group learners is the mixed-ability grouping. As figure 4.3 indicates, 17 respondents reported that they use mixed-ability grouping to group mathematics learners in the regular classrooms. Most of the respondents (11) who practice the mixed ability grouping claimed that sometimes the groups change as a result of swapping the learners between different groups. Only 6 in the same practice indicated that learners' groups never change throughout the year. Fewer respondents (2) cited other grouping practice and indicated that learners are grouped according to the merit list. Out of 2 respondents that practice other grouping strategies, 1 respondent agreed that sometimes learners change groups. On the other hand, the other respondent prefers not to change the groups. None of the teachers chose 'grouping by ability' as one of the grouping practices.

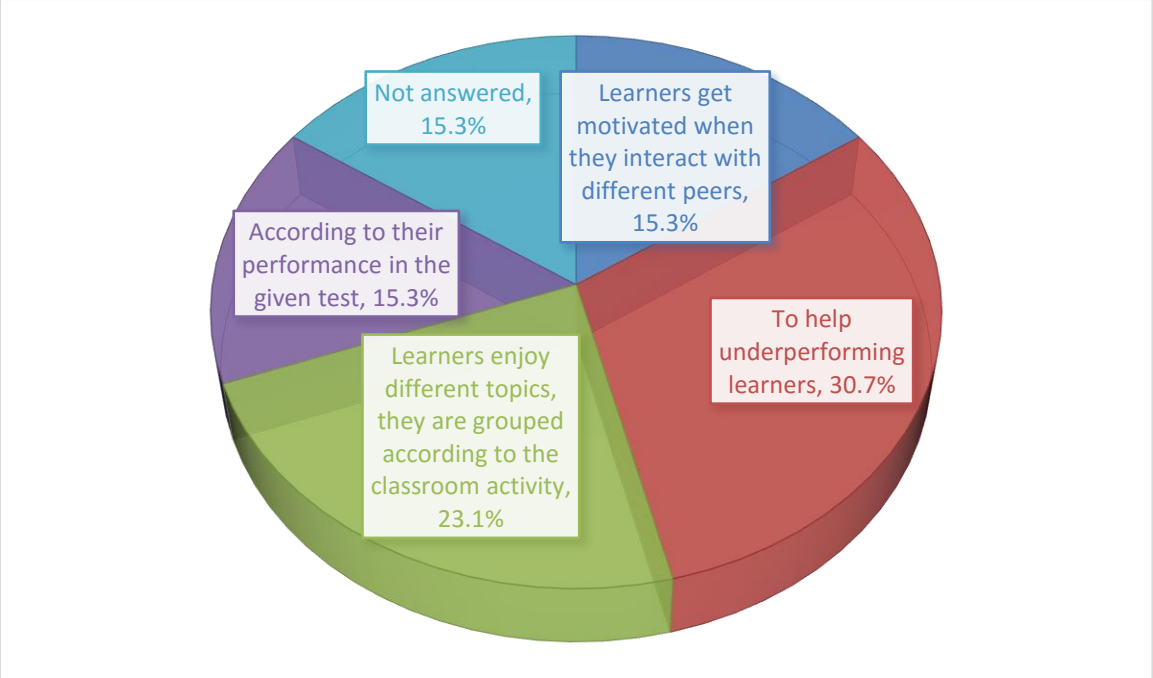


Figure 4. 3: Reasons for rearranging the learners' groups in the classrooms

As noted above, figure 4.4 shows that most teachers rearrange their grouping based on learners who act as peer tutors and the classroom activity. There are few teachers who swap their learners either for learners to get motivated when they interact with different peers or based on the test result.

'Do you motivate learners in your classroom?'

Table 4. 7: Learner's motivation in mathematics classrooms (n=19)

Answer	Frequency	Percentage
Yes	19	100
No	0	0
Total	19	100

The theme of supporting learners was then approached from a slightly different angle. The table above highlights the importance of motivation and all respondents (100%) believe that they motivate learners.

‘Do learners in your classroom have mathematics portfolios?’

Table 4. 8: Availability of mathematics portfolios in classrooms (n=19)

Answer	Frequency	Percentage
Yes	18	94.7
No	1	5.3
Not sure	0	0
Total	19	100

Turning back to the mathematics classroom, teachers were asked if learners in mathematics classrooms have mathematics portfolios. As table 4.8 suggests, 94.7% of teachers mentioned that such records exist and 5.3% indicated their absence.

‘Do learners in your school participate in mathematics competitions?’

Table 4. 9: Participation of learners in mathematics competitions (n=19)

Answer	**Frequency**	**Percentage**
Yes	14	73.7
No	5	26.3
Total	19	100

More specifically, how did participants responded to academic competitions for learners as initiated by the Department of Education? As table 4.9 indicates, 73.7% of teachers agreed that learners take part in mathematics competitions. The participants valued the use of competitions as part of their mathematics programme for certain learners.

4.2.4 Section 4: About Teachers of Mathematically Gifted Learners

'How comfortable are you in teaching mathematically gifted learners?'

Table 4. 10: Level of comfort when teaching mathematically gifted learners (n=19)

Answer	Frequency	Percentage
Very comfortable	13	68.4
Fairly comfortable	4	21.1
Neither comfortable nor uncomfortable	2	10.5
Fairly uncomfortable	0	0
Very uncomfortable	0	0
TOTAL	19	100

Table 4.10 shows that a high percentage of teachers (68.4%) feel very comfortable when teaching mathematics to gifted learners. Only 21.1% of them indicated that they are fairly comfortable. A small proportion of the sample (10.5%) was neutral about this issue.

'Mathematically gifted learners make your teaching in the classroom'

Table 4. 11: Levels of ease and difficulty when having gifted learners in the classroom (n=19)

Answer	Frequency	Percentage
Easy	4	21.1
Very easy	7	36.8
Neither easy nor difficult	7	36.8
Difficult	0	0
Very difficult	1	5.3
TOTAL	19	100

A large proportion of the sample (94.7%) admitted that gifted learners make teaching easy in their classrooms. Only a few educators (5.3%) indicated that having gifted learners in mathematics classrooms makes teaching very difficult.

How well do you think the needs of mathematically gifted learners are addressed in your school?'

Table 4. 12: How well are the needs of mathematically gifted learners addressed in schools (n=19)

Answer	Frequency	Percentage
Very well	4	21.1
Well	7	36.8
Adequately	7	36.8
Poorly	0	0
Very poorly	1	5.3
TOTAL	19	100

This table highlights a belief among most teachers (36.8%) that the needs of gifted learners are well addressed in schools. The same percentage (36.8) indicated that the needs are adequately addressed and 21.1% showed that the schools address the needs very well. Just 5.3% thought otherwise as indicated that the needs are very poorly addressed.

'Do you feel you need extra support regarding gifted learners?'

Table 4. 13: Extra support needed regarding gifted learners (n=19)

Answer	Frequency	Percentage
Yes	14	73.7
No	3	15.8
Not sure	2	10.5
TOTAL	19	100

Table 4.13 indicates that a large number of teachers (73.7%) in regular classrooms need extra support to teach gifted learners more effectively. Only 15.8% indicate that extra support is not necessary and fewer respondents 10.5% could not comment.

'If yes, in which areas?'

Table 4. 14: Areas in which extra support is needed regarding gifted learners (n=32)

Area	Frequency	Percentage
Teaching materials for gifted learners	11	34.4
Identifying gifted learners	2	6.3
Supporting gifted learners in the classroom	3	9.4
Supporting gifted learners outside the classroom	7	21.9
Monitoring gifted learners' progress	9	28.1
Total	32	100

The questions in table 4.14 were more practical issues of perceived extra support in relation to the different areas regarding gifted learners. The participants were allowed to choose more than one area. The largest single proportion (34.4%) suggested that teaching materials for gifted learners were appropriate. Other teachers (28.1%) appear to ask for extra support on monitoring gifted learners' progress, while there are also teachers (21.9%) who need training in supporting gifted learners outside the classroom. A smaller proportion of respondents, just fewer than 10% indicated that training is needed in supporting gifted learners in classrooms. A similar proportion also stressed the need for extra support in identifying gifted learners from other learners in classrooms is a relevant way.

4.3 Results from interviews

In addition to the quantitative data, qualitative data in the form of interviews were collected from ten interviewees teaching grade 10 mathematics. Their opinions can be seen as providing supplementary data in the form of a bird's-eye view of their understanding of how to support a gifted learner in the regular classroom.

Responses of teachers from the interviews.

1. **Do you have gifted learners in your classroom?**

Table 4. 15: Teacher's responses

Teacher	Response	Pattern
Teacher 4	"Yes I do"	There are gifted learners in classrooms
Teacher 7	"Yes I do"	
Teacher 8	"Yes"	
Teacher 3	"I do think I do have gifted learners, the thing is [pause] is you know, sometimes we are unable to give them attention or encouragement they deserve because they are just disappearing in the whole crowd."	
Teacher 6	"Yes, I have some who are gifted."	
Teacher 1	"Yes, there are not more than five."	
Teacher 10	"Yes I do"	
Teacher 2	"Yes, we do have gifted learners in the classrooms."	
Teacher 5	"Yes"	
Teacher 9	"Yes I do"	

2. **When did you realize you have mathematically gifted learners in your classroom?**

Table 4. 16: Teacher's responses

Teacher	Response	Pattern
Teacher 4	"Their performance indicated that they are gifted because they can reason and they would even write down whatever they are reasoning and you will see their marks that they are gifted. How they respond and how they ask questions you can you see that they are gifted."	When they perform in tests When they reason When they ask and answer challenging questions
Teacher 7	"When they started posing challenging questions and when I give them tests to test their previous knowledge, I could see that they have more knowledge that it is expected to be in the grade they are in."	When they ask and answer challenging questions When they academically perform

Teacher 8	“Because they always participate in class, they ask questions”	When they participate in classroom When they ask and answer challenging questions
Teacher 3	“When you teach, you will find out that certain questions they ask are challenging questions or if you raise your level of teaching a little bit gives them [hmm] a thinking question things like that. Yes, when you interact with them you find that yes, they are gifted, the way they answer questions.”	When they ask and answer challenging questions
Teacher 6	“I only observed it when I started teaching them after giving them an aptitude test.”	When they perform in tests
Teacher 2	“I can say in the first or second term. But what we normally do because they are the first time when they come from primary, before we can do anything we start with the baseline test. So, from there, you can see that we have perhaps few that they have an idea of what is happening in mathematics, and then after perhaps the first or second report is then you can be able to identify that these ones they really know what they're doing after assessing them.”	
Teacher 9	“During the first time when I have marked their informal first test, then I was aware that I have gifted learners.”	
Teacher 1	“During the informal test, when I give them tests. The manner in which they answer questions, I could see they are gifted.”	When they perform in tests When they ask and answer challenging questions
Teacher 10	“Those who participate and when I give them test those who obtain more marks.”	When they participate in classroom When they perform in tests
Teacher 5	“I realized through their participation in class and their performance in assessment.”	

3. **How have you identified gifted learners in your classroom?**

Table 4. 17: Teacher's responses

Teacher	Response	Pattern
Teacher 4	"Through their performance and through their responses."	Using their performance in tests
Teacher 7	"I have identified them using tests and also how they cope with a lot of work given to them, do they cope under pressure or do they need more time like other learners."	
Teacher 6	"By their performance after making the test which I gave them."	
Teacher 10	"Those who practice and get more marks. Those who passed my tests."	
Teacher 2	"Sometimes it will be when we do corrections for a test - let's say maybe I've given them a class work or homework I let them do corrections by themselves in the board and they explain what they have done. So you could see those who have passed because they can even explain what they have done there. So that sometimes helps me to identify gifted learners."	
Teacher 9	"Using tests. Especially tests that involve higher order questions, not the normal questions in the syllabus. Learners that are able to answer them confidently I deem them as mathematically gifted learners."	
Teacher 8	"Because they always participate in class, they ask questions."	By looking at their participation in classroom
Teacher 5	"I identify them according to how they participate in class and also according to (pause) after the assessment (ehh) the grades that they are having the assessment. That brings me to a conclusion that they perform very well and also how they respond to questions during the assessment."	
Teacher 1	"[Laughing], is it not the very same question [laughing]. Ohooo, yes when they write tests, especially informal tests, we are able to see that they are gifted. The manner in which they answer the question and they respond to other questions we can see that they are gifted."	Using their performance in tests By looking at the manner they ask and answer questions
Teacher 3	"I must really be honest. Although I know that there are gifted learners [eehh] [pause] [eehh] just [eehh] at the moment I had to	

	resort to the only method that I am familiar with which is the merit list, and I know is that not the right way. But I could not do [hmm], I don't think time restricts us to go a little bit you know by different types of questions we just stick to these assessments that we give to them."	

4. **Why do you feel that that the process of identifying gifted learners was easy or difficult?**

Table 4. 18: Teacher's responses

Teacher	Response	Pattern
Teacher 4	"It was easy because the kind of classes that we have these days, are arranged in such a way that every learner in the class. In the classroom, you'll find different kinds of gifted, slow learners and average, so it is very easy to detect a gifted learner. The difficult part would be that when you compare you gifted learner with other classes because you are not teaching only one class, you wonder whether this one that you think is gifted is really gifted."	Easy when teaching one class Difficult when teaching more than on classes
Teacher 7	"I think the process was easy because most of them with regard to the way you teach them, there are those learners that you feel they are more challenging and you know when you go to certain classes you should be prepared to also answer questions that are more than academically acceptable to them"	
Teacher 8	"Because the education system presently we have few challenges in the sense. As an educator, we are restricted to not individual learner development, but to the maths teaching because the completion of the syllabus is number one priority and the second thing the department expected results, they do not expect quality result most of the time. They expect like pass rate', they focus on pass rate. We tend to relax and say that ok, our priority is to get 30% pass and the rest they will take care of themselves. That is unfortunate, it is a sorrow state. Although we have good intentions, if we had freedom and not restricted by these common things like common tests, I think we would do better."	

Teacher 6	“In my part, it was easy because I got it through giving a test as well as through interactions with my learner's, that's how I got to understand how to identify gifted learners.”	
Teacher 1	“I would not say it was difficult. The only tool that we use I think the basic tool is of the test. I don’t think it is difficult.”	
Teacher 10	“Because they know what they are doing and they come and ask questions if they have any.”	
Teacher 2	“(Umm) it's easy because I get into the class every day, I deal with them every day and we have double periods every day. It's quite easy even if you have time with their books because we do have students who are not active in the classroom. But obviously, when you now control their books and you fill in their marks you can be able to check which child is very strong and because he knows his stuff and that works for me in identifying them.”	
Teacher 5	“Yeah, it was not easy to identify them because the assessment actually does not come now and then because we are having too many learners in classes. So it is not easy to recognize them, only recognize them after the assessment, actually, the formal assessment that this is a gifted learner according to how he or she achieved per assessment.”	Difficult because of too many learners in classrooms
Teacher 9	“Identifying of gifted learners it's a bit of challenge because a gifted learner is not a learner that is not going to answer all questions confidently. It is all about a learner that is able to use higher order reasoning in his or her answers. We pick these things up if you set a test and you know that it is of level 5 questions and if a learner is confident enough to answer the question using a variety of methods then we deem a learner as a gifted learner. Not only within the prescribed method the teacher taught in the class but using other methods that are beyond the scope of the curriculum.”	Difficult because of the type of assessment

5. What resources do you use to teach your learners?

Table 4. 19: Teacher's responses

Teacher	Response	Pattern
Teacher 4	"(Hmmm) I am an old teacher I still use chalkboard; I try to use technology because sometimes I will present from the laptop."	Chalkboard Computer
Teacher 7	"I use textbooks, projectors and there is a programme called IPP and AMET and I also use the chalkboard. The game at SA Post them that is loaded on the computers, where you just connect on the projector and you let the learners watch other ways of doing mathematics and where can they apply certain concepts of mathematics. The IPP where teachers are being taken to Vista and they teach them in other ways of dealing with previous question papers."	AMET Chalkboard IPP Textbooks
Teacher 6	"Aaaa there are so many things that we use, it comes from video, audio, (pause) depends on the day, chalkboards (pause) there are so many things that we use."	Audio Chalkboard Videos
Teacher 1	"We usually use textbooks and we also use have a HEYMATHS - it's a software that is designed for Mathematics from grade 1 to grade 12. We also use what is called Internet broadcast project IBP or which is administered by the University of the Free State. It is where educators are being used to teach maths and then learners are able to get the videos apart from the chalkboards and everything else like textbooks."	AMET IPP Textbooks
Teacher 10	"Resources such as textbooks and those materials that we get from PLS workshops we are attending every fortnight, so I use those."	Textbooks
Teacher 2	"I prefer HEYMATHS a lot. It has practical examples and they can see what you are talking about and enjoy it. I use HEYMATHS and textbooks and also previous question papers. Those are the resources that I use most of the time."	AMET Textbooks Previous question papers
Teacher 5	"I use the computer for mathematics and also the whiteboard marker, the textbook, (yeah, yeah) and other learning materials and I Google in most cases (pause) especially on how to transfer knowledge to learners. Because most of my classes I teach the grade 8 mathematics. Yeah, we use HEYMATHS. It's a mathematics	AMET Computer Textbooks

	program. It is in line with the CAPS curriculum CAPS document."	
Teacher 9	"I use the prescribed textbooks and previous question papers. And I try to use as many resources from other textbooks as possible and a variety of sources beyond the scope of the curriculum. The reason I do that, I want to identify the learners that I deem as gifted by using the resources that are Beyond the scope of the curriculum."	Previous question papers Textbooks

6. **How do you assess gifted learners in your classroom?**

Table 4. 20: Teacher's responses

Teacher	Response	Pattern
Teacher 4	"Give them more work than the others so that they should not get bored because if you give them the same work as hard as they get bored, so you have to give them something extra that could keep them busy with their work."	Gifted learners should be given more work
Teacher 6	"Gifted learners I give them extra work. And I see I have given some learners who are slow learners some work to do they are not yet done, and gifted learners have already finished I give them extra work to do which is more challenging than what others have been given."	
Teacher 10	"(Mmmm) I give them Glassworks, more work and I also use previous question papers."	
Teacher 7	"I can't say I assist them in a special way but I just make sure that in a question there are different kinds of questions where you can cater for the slow learners, the average, and for the gifted learners. So my questioning techniques have to vary."	Gifted learners are assessed the same way as slow learners
Teacher 1	"No, I think learners in our school they receive the same assessment so we don't have an assessment for gifted learners and assessment for average learners and then they receive the same assessment. The only difference is that the gifted would excel in our assessment and then the average will get about 50 percent and those struggling will be getting the level 1. So we don't have different forms of assessment in our classrooms."	

Teacher 5	"I assess them, I use projects to assess them, assignments, and also formal tests. Some of the tests are not set in the school and some are set from the Department which could be used as the external assessments."	

7. **Do you feel that gifted learners should be given the same or challenging activities than their classmates?**

Table 4. 21: Teacher's responses

Teacher	Response	Pattern
Teacher 4	"If you don't give them more challenging work, they will finish early and they will disrupt the class. Give them extra work and improve their quality as well."	Gifted learners should be given challenging activities than their classmates
Teacher 6	"Right at first you give them the same level of content with other learners but as you see are progressing you give them more advanced which is more sort of challenging work as compared to others."	
Teacher 1	"I think if they were given more challenging activities it would anyway improve their mathematical skills. If it was possible they would receive a different assessment from those who are average and those who are struggling."	
Teacher 2	"I think they should be given more challenging than other students."	
Teacher 5	"(Yeah) to boost their performance for that particular subject we can give them most difficult questions to expand their ability."	
Teacher 9	"Yes. Everything to them is easy so those learners have to be challenged.	
Teacher 7	"I don't think it's fair. I think it is much fair when because learners are gifted and yes it is, but I think it's not fair for them to get more challenging questions."	Gifted learners should be given the same activities with their classmates
Teacher 10	"I think that it will be a problem to give them more challenging activities because I think it will discourage others, the slow learners they will think others are better than them so they must be given the same."	

8. **Why do you feel that gifted learners should be given the same or more challenging activities than their classmates?**

Table 4. 22: Teacher's responses

Teacher	Response	Pattern
Teacher 4	"(Laughing) I think is to unfold their potential. Like as if indicated, if you give them the same weight as all they still will get bored and their work will deteriorate, but if you give them extra at least you are catering for that intelligence."	To unfold learners' potential To avoid boredom and frustration
Teacher 7	"Because sometimes they feel like if you give them easier questions, they feel like you are wasting their time and this is not for them, they feel like they are too intellectual and this is not the grade that they supposed to be in because these things are too simpler for them. They started to get bored and lose interest in the subject."	To avoid boredom and frustration
Teacher 5	"Because they perform extraordinarily, and because they have got a special type of ability in terms of approaching problem-solving and so forth. More challenging assessment or difficult question problem solving to average performing learner it might come as the discouragement form and we don't want to discourage average performing learners."	
Teacher 1	"They must be given more challenging activities so that their mathematical skills can be improved.	To improve their mathematical skills
Teacher 2	"Most of the time they are fast. If you don't give them more work it means that they will be idling around and doing nothing, do you understand? And it's also to improve them. They cannot just sit and do nothing you must just give them more work so that they get used to and practice, sort of practicing again. It is never enough so the more the better."	
Teacher 6	"Gifted learners when given challenging it promotes them to think further than they are listening so that they can upgrade their ability of reasoning."	To improve their reasoning ability
Teacher 9	"Any problem if you put on the board the learner can answer it. To them is not as challenging as the rest of the learners. So to challenge learners to think mathematically, to	

	have a higher order reasoning that is needed in the university you need to give them other sources that are beyond the scope of the curriculum. And we as teachers we have to guide their reasoning."	

9. **Why do you feel that having gifted learners in your classroom makes your work easy or difficult?**

Table 4. 23: Teacher's responses

Teacher	Response	Pattern
Teacher 4	"The easy part like I said it's very frustrating, it frustrates especially if you are a maths teacher, to teach mathematics because of the stress that we are getting and learners that are not performing- that are not doing well in mathematics. So it makes for me in terms of reporting, if we are forced to report why learners are failing, we just tell them that if this one can make it in the same class, what is wrong with others. So it makes my work or somehow my accountability easier because they will be the ones that you will refer to sometimes. People think that maths teachers do not know mathematics or they are not teaching at all, so it makes it easier for me to prove that I'm doing what I'm expected to do, even though sometimes it is not up to the standard of whoever is looking for a particular standard."	Having gifted learners makes teachers' accountability easier
Teacher 2	"(Hmm) it makes my work easy because really is not nice to teach the class and then all of them they fail. Somehow you need to get those learners who would pass. It's really encouraging again to a teacher when given learners that they cooperate. It is sort of a motivation to the teacher."	
Teacher 1	"Makes it easy in the sense that they are able to explain some of the concepts to learners, they are able to share their understanding with other learners in the class. Sometimes as a teacher you might think that you are explaining things adequately but sometimes learners don't understand. But when such learners explain some of the things they are able to understand."	

Teacher 10	"(laughing) their participation encourage you and you know you have to be prepared when you go to classes. When you have given them work, they will come and ask what is going on here and when you are doing corrections they will be the ones that will come to the chalkboard and will explain to the class."	Gifted learners make teaching easy because they can explain to their classmates
Teacher 7	"It makes my work easy because I don't have to explain one thing over and over again. If I don't have time, some topics I don't have to teach them, I just give them as own activities and send them home. They just go find what is needed on their own and if they have questions they just come and I help them here and there."	Gifted learners make teaching easy because teachers do not have to repeat their work
Teacher 5	"It makes my work easy because of I don't take a long time struggling to explain a concept to a gifted learner than when they are mixed. Because when they are mixed with average performing learners you must take time to explain a concept to a particular learner, and you have got various questions some of them are irrelevant some are relevant and you need to be patient with them."	
Teacher 9	"Basically the things you give to them, they will answer. You will have to prepare more and get more resources and you have to be on your game because those learners will challenge your thinking, which is nice and makes education nice. It makes your job easy because you know that you are teaching future mathematicians, scientists, and engineers."	Teachers need more preparation and resources to teach gifted learners

10. What makes you comfortable or uncomfortable when teaching mathematically gifted learners?

Table 4. 24: Teacher's responses

Teacher	Response	Pattern
Teacher 1	"The only thing that will make me comfortable when teaching those learners, is my mathematical knowledge and skills. If I have different methodologies of delivering the	

	content to the learners, I think that will make me confident as a teacher."	
Teacher 4	"Comfortable is because you can always try all the ways and show learners the other approaches. But the uncomfortable part becomes the learners who are struggling and get confused because you are teaching in class and you want these ones to have all the ways of doing these things so that they can have a choice - but on the other hand the struggling learners get confused."	Teachers have different approaches to delivering the content
Teacher 9	"What makes me comfortable is that these learners know how to think. I don't have to tell them how to think and how to approach a problem, I will have one method then they will have five methods of approaching the very same problem. So these learners know how to think mathematically, so it makes my job very easy when dealing with these learners. Perhaps they might struggle here and there but my job is to guide them, not actually the answer but the thinking process."	
Teacher 7	"What makes me comfortable is the fact that I know that I am going to present to a class that is challenging. It makes me want to be prepared more and research more on the topic that I am going to teach. I don't just go to a class unprepared. I make sure I prepare on time all my lessons are prepared. Every question that they might pose I also know that I'm prepared as well so that it becomes challenging as a teacher as well."	Teachers need more preparation and resources to teach gifted learners
Teacher 6	"The Gifted learners their response it makes me to cover the syllabus within a short period of time because they quickly master what I teach, unlike slow learners. That's why it makes my life easier especially when teaching gifted learners because I work within a short period of time as compared to those who are slow learners."	Teachers feel comfortable because they complete the syllabus in a short period of time
Teacher 2	"What makes me comfortable is that I know that I will reap whatever that I have sowed. The results to me mean that my hard work did not go unattended. It's a pain (yaaa), it reliefs the teacher to see that you had done something then after you get good results."	Having gifted learners makes teachers' accountability easier
Teacher 5	"It is not that I'm comfortable because mathematically gifted learner each and every mistake or error that you commit they are on	

	top of you. They can detect easily when you made a mistake."	

11. What do you think are the best strategies to support gifted learners?

Table 4. 25: Teacher's responses

Teacher	Response	Pattern
Teacher 6	"The best strategies to support gifted learners would be to give them more extra work - if we can say include them in regional examinations or some school competitions or the country competitions so that they get exposed to the world. I think that would help them now to uplift the ability to master more in mathematics."	Extracurricular activities
Teacher 10	"I think entering competitions and participating with other schools in mathematics. They explore when you take them somewhere so that they can learn better."	
Teacher 9	"The best first teaching is not the best method to teach learners. I think it is learners have to be exposed other learners like them in other schools and they have to enter competitions. There are Olympiad competitions and they need to enter. If there are AMESA competitions, they still have to enter these competitions. So that they are in an environment where they feel that they are solving the same problems with their fellow learners. They are not in an isolation as they are in the classroom, they are with other brilliant maths students so that they can feel comfortable."	
Teacher 2	"Ok, ways to support sometimes forming groups they must form groups themselves and give them problems so that they help each other. Sometimes you intervene in the very same groups. That would be the first thing, forming groups themselves and intervening as the teacher and helping them out. One another thing that you can do to support them is to give them more work and then you check their work because whenever they are struggling you can pick it up and be	Group work

	able to assist them when they are face challenges.”	
Teacher 5	“The best ways to support gifted learners is that you have to make them work, create groups, make them group leaders, give them the work like (errr) or make them your tutors. You are a teacher make them tutors. After teaching something or topic they must assist other learners. That is how I think you should or gifted learners should be supported so that they can transfer this knowledge to others and realize that how much they know. Because when they transfer that knowledge to other learners they are going to be confronted by a lot of questions and it is then they will realize how much do they know and how much they don't know.”	Group work
Teacher 1	“I don't know whether mine is the best. But what I usually I would make copies of maybe some concepts and give to them, and say to them 'study this and then I'm giving you 10 minutes' and we would discuss that thing. Sometimes don't even need me to explain, they are able to do these things on their own. So we with the gifted learners I think that is the best method because they are... what do they call? (asking a question)....they are finding things on their own.”	Gifted learners can work on their own
Teacher 4	“In my view, the best strategies to support gifted learners will be if they are isolated - if we can isolate them, they will get everything that they need. We don't have to worry whether the kids they understand or follow. So they will have much more time to express themselves, to do everything they want without any hassle or any worry that other learners will be left behind totally. To isolate them, with the current situation is impossible. If maybe teachers can be increased in such a way that mathematics teachers are responsible for aftercare for only gifted learners so that we can cater for them. What we have seen in schools nowadays we no longer even cater for the gifted learners, we always looking out for the underperforming learners.”	Gifted learners should be taught separately

12. What do you think is the impact of your teaching strategies on gifted learners' achievement?

Table 4. 26: Teacher's responses

Teacher	Response	Pattern
Teacher 5	"The way I teach them it is like I don't treat them differently from average performing learners, it's just that I give them extra work on top of those average performing learners. It is not that I treat them differently, I think that is the impact that I do on their performance."	There is no impact of teachers' strategies on gifted learners
Teacher 9	"Of the number of gifted learners we have this us the number of average learners, our teaching strategies are primarily based on those learners that are weak. So in the classroom, you will do those basic things that require a basic understanding. In the classroom I might not be able to cater for those gifted learners all the time, that is why I have to get those extra learning materials like TIMS over the time and give them to the learners perhaps during the study time or break. I think we are more focused on the getting the week learners to pass rather than making the Gifted learners to fly."	
Teacher 4	"I think I'm allowing the gifted learners to express themselves because I usually give them questions to work at home and are beyond school program. We allow them to be on their own in the computer lab to also check other stuff that they can do mathematically."	Gifted learners can express themselves
Teacher 6	"The impact of my strategy it helps a lot especially to gifted learners especially they excel better than the others and those who are slow learners because is not like leaving them at the level which they are already operating, they exceed the level of others who are slow learners because I use different teaching strategies."	Gifted learners excel than their classmates
Teacher 1	"I don't know how to answer that question (laughing). I think it enhances their performance. Because in those resources, the IBP and the HEYMATHS sometimes you'll find that some concepts are being taught in a different way, so would say that improves their performance."	Teachers' strategies improve gifted learners performance

Teacher 10	"It differs, others pass, others underperform. I've noticed that others they don't practice. If they are going to write a test you have to push them, when they are at home they don't do their work."	Teachers' strategies impact gifted learners differently

13. What kind of support or training would you find appropriate regarding teaching gifted learners?

Table 4. 27: Teacher's responses

Teacher	Response	Pattern
Teacher 4	"I think if it could be (ehh) or if I can, which is impossible because of the commitment and the responsibility. If I could get support in terms of technology, how to utilize mathematical tools and everything on a computer- at least I will be able to generate questions on a computer that will help to support the gifted learners as well."	Teachers need to be supported by technology based-materials
Teacher 6	"We need more support to teach the gifted learners in terms of facilities in our classrooms. We need instruments, we need some computers sort of, because we're towards computer technology especially in algebra in class I think that could help a lot with these gifted learners."	
Teacher 9	"I think it is really important that the workshops have to be done because mostly workshops from the Department will always be how to get weak learners pass. They are seldom about how to make those top learners that are gifted, I don't mean the average ones, reach for the sky. So teacher training and workshops are more important. For teacher training, the emphasis should be more equal to teaching the Gifted learners and slow learners."	Teachers need more workshops, training and help one another to teach gifted learners
Teacher 2	"Most of the time we go to workshops, even in our schools we do have..... Let's say for example when I started teaching I did not get probability and it was the subject that I did not like, so as to say. So somehow I would feel that I was not doing Justice to the learners, I would just touch it here and there (laugh). So what we normally do, we help one another. I would just ask one of my colleagues to come	Teachers need more workshops, training and help one another to teach gifted learners

	and present the topic for me, you understand. That helps a lot. You think of geometry we'll just ask my colleague an assist, but I don't leave during that time because I need to observe. When I started teaching, I would observe one of my colleagues and then the second period I would present it myself. So that helps a lot in the chapters that you are not comfortable or those that you don't prefer teaching. We have that thing in our school of supporting each other in getting mathematics right."	
Teacher 1	"Currently as maths teachers, I don't know whether in South Africa or in the Free State we have what we call the PLC where maths educators every Friday meet to discuss the content that must be taught to the learners. It is helping us very very much because you would find that you are able to get assistance with what you are struggling with. Maybe if you are struggling with algebra, you'll find another teacher from another school who has other methods of teaching that concept, so we have that which is helping us a lot."	Teachers need more workshops, training and help one another to teach gifted learners
Teacher 5	"(Mmmm) for myself I think because South Africa is a developing country we have 40 learners in one class and again it's a mixed culture - gifted learners and also average performing learners, so the support that is needed is that they have to be separated and work with them independently gifted learners and average performing learners. And then by that time, you can meet them but in South Africa, it is a bit difficult because in our schools especially Township schools it is a bit difficult to work with them like that, independently or separately. So that is the support that is needed for my site to work with them separately - the class of gifted learners and the class of average performing learners, because when they are mixed it will be like they we are consuming the time of these gifted learners whereas the average performing learners need some time to explain a concept."	Gifted learners should be taught separately

Categories in the data

Table 4. 28: Categories in the data

Patterns	Categories
There are gifted learners in classrooms	Teachers have gifted learners in their regular classrooms
When they perform in tests	Academic performance
Using their performance in tests	
When they reason	Nomination based on teachers' perception and experience
When they ask and answer challenging questions	
By looking at the manner they ask and answer questions	
When they participate in classrooms	
By looking at their participation in classroom	
Audio	Enrichment
AMET	
Chalkboard	
Computers	
IPP	
Previous question papers	
Textbooks	
To unfold learners' potential	Acceleration
To avoid boredom and frustration	
To improve their mathematical skills	
To improve their reasoning ability	
Gifted learners should be given more work	Differentiation
Gifted learners are assessed the same way as slow learners	
Gifted learners should be given challenging activities than their classmates	
Gifted learners should be given the same activities with their classmates	
Extracurricular activities	Mathematics Competitions
Group work	Grouping learners
Gifted learners can work on their own	
Gifted learners should be taught separately	
Having gifted learners makes teachers' accountability easier	

Gifted learners make teaching easy because they can explain to their classmates	Teachers' attitude towards gifted learners
Gifted learners make teaching easy because teachers do not have to repeat their work	
Teachers need more preparation and resources to teach gifted learners	
Teachers have different approaches to delivering the content	
Teachers feel comfortable because they complete the syllabus in a short period of time	
There is no impact of teachers' strategies on gifted learners	Teachers' beliefs about the impact of their teaching strategies on gifted learners
Gifted learners can express themselves	
Gifted learners excel than their classmates	
Teachers' strategies improve gifted learners performance	
Teachers' strategies impact gifted learners differently	
Teachers need more workshops, training and help one another to teach gifted learners	Teachers need support

Themes that emerged from the categories

Table 4. 29: Themes that emerged from the categories

Categories	Themes
Teachers have gifted learners in their classrooms	How teachers identify mathematically gifted learners
Academic performance	
Nomination based on teachers' perception and experience	
Enrichment	What do teachers believe are the best strategies to support mathematically gifted learners?
Acceleration	
Differentiation	
Mathematics Competitions	
Grouping learners	
Teachers' attitude towards gifted learners	

Teachers' beliefs about the impact of their teaching strategies on gifted learners	The impact of teachers' strategies on mathematically gifted learners
Teachers need support	

Table 4. 30: Themes as linked to research questions

Themes	Research questions
How teachers identify mathematically gifted learners	How do teachers identify gifted learners in mathematics?
What do teachers believe are the best strategies to support mathematically gifted learners?	What instructional strategies do teachers use for supporting mathematically gifted learners?
The impact of teachers' strategies on mathematically gifted learners	To what extent are teachers' instructional strategies meeting the needs of the gifted learners?
Supporting teachers of mathematically gifted learners	

4.4 Summary of Findings

The responses from both questionnaires and interviews have been presented in relation to the aim, research questions, and objectives of the study. The headings for reporting the data derived from the key themes that were identified can be summarised as follows:

4.4.1 How teachers identify mathematically gifted learners

Discussion of how teachers have identified gifted learners centered, not surprisingly around learners' academic potential and attainment. Teachers reported that learners are distinguished according to those who get high marks in the subject tests (formal or informal) and the manner in which they answer questions and participate in class. On the other hand, regarding the ease or difficulty of the process of identifying gifted learners, some teachers mentioned that the process was easy because of the willingness of learners to answer questions. Regarding the difficulty, the main reasons mentioned were that there is only one tool (which is the results of the tests) to identify gifted learners, it is difficult to compare high achievers with learners in other classes in order to conclude that they are really gifted.

4.4.2 How teachers teach mathematically gifted learners

On the question of what resources teachers use to teach learners, respondents gave a detailed explanation of the activities and the resources used for teaching and learning. Teachers mentioned that they occasionally use extra support materials which they give to both gifted and average learners. Teachers explained that these materials range from chalkboards, textbooks, computers to the use of programmes like the Internet Broadcast Project (IBP) and the HeyMath which are very helpful to the learners.

In response to the question, on why teachers feel that gifted learners should be given the same or more challenging activities (depending on the teachers' previous answer) than their classmates, all of the respondents stressed out that more work should be given to the gifted learners and listed the following reasons:

a. If they are given the same activities as slow and average learners, they will get bored and their work will deteriorate.
b. If given easier questions, they feel like their time is being wasted.
c. They need challenging activities to increase their mathematical skills
d. Since most of them are fast, challenging activities keep them busy and they do not disturb other (slow and average) learners.

Regarding how teachers feel about teaching mathematics to gifted learners, eight teachers mentioned that they find it comfortable to work with gifted learners. Teachers explained that they go to classes prepared and having researched more about the topic to be presented. Respondents further point out that they reap for their hard work. But two of the respondents stated that they did not feel comfortable in the presence of gifted. Teachers openly admitted that lack of confidence in delivering the content makes them feel uncomfortable.

4.4.3 What do teachers believe are the best strategies to support mathematically gifted learners

Teachers were asked in the interview what they thought were the best practices to support mathematically gifted learners in their classrooms. Respondents mentioned different practices including isolating, grouping learners, giving them extra work. Making them tutors and allowing them to enter competitions like The Association for Mathematics Education of South Africa (AMESA).

4.4.4 Supporting teachers of mathematically gifted learners

A large number of participants (73.7%) indicated the need of support in teaching gifted learners in their classrooms. Teachers mentioned they need to be supported by technology-based equipment, teaching gifted learners' materials and trainings or workshops aimed at gifted education.

CHAPTER 5: DISCUSSION OF RESULTS, CONCLUSION, AND RECOMMENDATIONS

5.1 Introduction

This chapter presents the discussion of results, conclusion, and recommendations. In the light of the literature review on chapter 2, and the findings on chapter 4. The present chapter discusses the results of the study and further presents some recommendations and implications. The main aim of the study was to investigate strategies which teachers use when they support mathematically gifted learners in their inclusive classrooms. Literature on gifted education suggests that for teachers to be able to offer appropriate support for gifted learners in their classrooms, the starting point is to identify those learners. This then took the study into the discussion of findings of the first research question.

5.2 Discussion of findings

The results and the analysis of data are presented and discussed according to the identified themes of strategies used by teachers for supporting mathematically gifted learners in high schools and in light of the research questions which the study intended to answer.

5.2.1 How do teachers identify gifted learners in mathematics?

i) Teachers have gifted learners in their classroom

The first issue of the present study was to investigate strategies which teachers use to identify gifted learners in mathematics classrooms. The results of the questionnaire survey revealed that almost all of the teachers (95%) agreed that they had learners whom they view as gifted in their regular mathematics classrooms. Although teachers indicated that they use different methods to identify gifted learners, assessment results were in fact very popular method used for the identification of gifted learners (84%).The nomination method was also popular with 68.4%, and respondents also selected methods where learners are identified by

other teacher or previous school (10.5%), identified by parents (10.5%) and used other methods to identify (10.5%). The findings also revealed that the majority of teachers (47.4%) were not sure about how gifted learners can be identified.

The interview results confirmed that all teachers agreed that they have gifted learners in their classrooms. Discussion of how teachers have identified gifted learners centered, not surprisingly around learners' academic potential and attainment. Teachers reported that learners are distinguished according to those who get high marks in the subject tests (formal or informal) and the manner in which they ask and answer questions, and how they participate in the classroom.

ii) Academic performance

Results show that academic tests is mostly used by the teachers (about 84%) to identify gifted learners. As the results suggest, some research has shown that the use of academic tests only does not necessarily identify gifted learners. Terman (1926) warned against total reliance on tests arguing that: "We must guard against defining intelligence solely in terms of ability to pass the tests of a given intelligence scale" (p. 131). Similarly, Thorndike (1921) had earlier stated; "to assume that we have measured some general power which resides in [the person being tested] and determines his ability in every variety of intellectual task in its entirety is to fly directly in the face of all that is known about the organization of the intellect" (p. 126). Other studies have also shown that underrepresentation of learners from previously disadvantaged backgrounds results in a large part from improper identification practices based on mostly invalid definitions of the key concepts of giftedness and talent, but especially what Borland (1997) has labeled the "socially constructed" giftedness concept. For her part, Ford (2003) puts the blame on the educational system, more specifically (a) on "the pervasive deficit orientation that prevails in society and our schools," (b) on "low referral rates of diverse students" by teachers, (c) on an almost exclusive reliance "on tests that inadequately capture the strengths and cultural orientations of these students," and (d) on "educators" lack of understanding of cultural diversity" (p. 507).

iii) Nomination based on teachers' perception and experience

The analysis of the study revealed some illuminating points regarding teachers' perception of mathematically gifted learners. The responses of participants about their perception of giftedness are centered around cognitive abilities. When they were asked how they identified gifted learners in their classrooms, teachers emphasized mostly on the reasoning ability, problem-solving ability and their (learners) attitude towards mathematics as gifted characteristics to identify gifted learners. Even the stated features indicate that teachers are aware of the valuable characteristics of giftedness, participants do not mention some other abilities such as generating original ideas, being speculative and offering unusual unique answers or solutions. These unstated characteristics of gifted learners are mostly believed as difficult to deal with in regular classrooms. Teachers portray these features as in line with the destructive behaviors in the classroom.

Nomination that is based on teachers' perceptions is recommended by other researchers (Gardner, 2011; Ramos-Ford & Gardner, 1997) as an intelligence-fair nomination when it involves achievement of learners, behavior and working styles under an environment that encourage the gifted behavior. Nominations based on current teachers are also believed to support the identification of mathematically gifted learners, but on condition that teachers have been trained in what they search for (Freeman, 1999). This is because untrained teachers can mistakenly confuse gifted learners with well-ordered and organized learners, resulting in inaccurate nomination.

Some research has shown that the use of nomination by teachers and sustained academic performance do not necessarily identify gifted under-achievers. This kind of nomination may also be subject to teacher's bias and restricted to what is only observable, therefore it should be combined with other kinds of nominations such as peer-nomination and parent-nomination (Dimitriadis, 2010)

5.2.2 What strategies do teachers use for supporting mathematically gifted learners?

i) Enrichment

The study revealed that teachers believed that they were enriching their curriculum for gifted learners in their classrooms. The participating teachers provided much data showing that they use enrichment. However, the strategies of enrichment described by the teachers varied significantly. Most of the teachers used the prescribed mathematics textbooks, videos, and previous question papers to assess their learners. Some use extra support materials which they mainly find through resources that are available online like HeyMath-which is a web-based platform that enables every teacher and learner to learn from the 'best teacher in the world' and to benchmark themselves against their peers globally. The HeyMath program offers workshops on best practices in lesson planning, strategies for remediation and enrichment workshops which provide exposure for learners beyond the curriculum.

Teacher 9, who was aware that gifted learners think in a different way from the rest of their peers, highlighted that it used different teaching materials to meet the needs of all the learners in its classroom and more importantly to identify the gifted ones. Teacher 9 explained:

> *"I use the prescribed textbooks and previous question papers. And I try to use as many resources from other textbooks as possible and a variety of sources beyond the scope of the curriculum. The reason I do that, I want to identify the learners that I deem as gifted by using the resources that are beyond the scope of the curriculum."*

Teacher 9 considers the use of the prescribed textbooks and previous question papers, given to all the learners in his classroom, enriched for gifted learners

ii) Acceleration

By considering the findings on acceleration strategy for gifted learners, the study suggest that teachers have a complete view of meeting the needs of gifted learners in the regular classroom. Teacher 7 is aware that gifted learners feel that their curriculum should be accelerated by not doing the same content as their grade level peers:

> *"Because sometimes they feel like if you give them easier questions, they feel like you are wasting their time, and this is not for them. They feel like they are too intellectual, and this is not the grade that they supposed to be in because these things are too simpler for them. They started to get bored and lose interest in the subject."*

This comment is in line with teacher 4 who stated that if the curriculum of gifted learners is not accelerated, they will get bored and their work will deteriorate. This teacher reported one need of catering for the learners' intelligence, is to give them extra work:

> *"… I think is to unfold their potential. Like as if indicated, if you give them the same weight as all they still will get bored and their work will deteriorate, but if you give them extra at least you are catering for that intelligence."*

Teachers in the regular classrooms would need to make necessary adaptations. There are learners in mathematics classrooms who may know what is being taught in the classroom as well as those who are capable of grasping what is being taught to the rest of the class within a short period of time. These learners need to be provided with individual or group work which keeps them engaged in tasks and contributing to higher cognitive demand. These tasks may highlight the need for learning advanced content. Within the regular classroom setting, the choice for individual learners to follow their special interest as well as the time for undertaking these individual enquiries could be provided by some kind of curriculum acceleration, which involves realigning material that has been understood by learners (Alqefari 2010). Acceleration methods are not used by any of the teachers who took part in this study.

Although limited, the research (Lee, Olszewski-Kubilius, & Peternel, 2010; Robinson, 2004) indicates that acceleration is a good strategy option for gifted learners. Olszewski-Kubilius (2007) and his team (Paula Olszewski-Kubilius, Lee, Ngoi, & Ngoi, 2004) noted that gifted learners who participated in a multiyear program that offered enrichment and advanced curricular to prepare mathematics learners during middle school was effective. In a follow up interview with these learners, Lee, Olszewski-Kubilius and Peternel (2009) discovered that the learners

perceived that the acceleration program was instrumental in preparing them for the following grades in high school, which they believed was the best feature of the program.

iii) Differentiation

As for differentiation, this study found that teachers had different opinions how gifted learners should be assessed. Some of the teachers believed that challenging activities were necessary for mathematically gifted learners than their classmates to improve their intellectual skills. They also mentioned that if gifted learners are not challenged, they will finish earlier than their classmates and disrupt the classroom. These results are supported by Launder (2011a), who conducted a study on supporting gifted learners in the regular classroom through differentiated instruction. The study found that learners in the FIND (Further Interests and Nurturing Development) program enjoyed the challenge that was presented with the independent study. Teachers and learners felt that providing gifted learners with challenging work is necessary for their intellectual growth. The study also points out that while teachers acknowledged the need for challenging work, they seemed to have particular difficulty.

The results of this study suggest that the strategies used by teachers in mathematics classrooms were differentiated to some degree and the differentiation did not extend far enough to give the gifted learners the choice, challenge, and flexibility they need in the classroom. Clark (2008) outlines the cognitive needs of gifted learners to include being exposed to new challenging information in mathematics and being allowed to pursue ideas as far as they want. When asked, the teachers wanted to give more challenging activities to the learners, but the structure of the classroom does not allow that. This is illustrated by comments from Teacher 1 such as:

> *"I think if they were given more challenging activities it would anyway improve their mathematical skills. If it was possible they would receive a different assessment from those who are average and those who are struggling".*

Teacher 1's interest in improving the mathematical skills for the learners coincides with the concerns of researchers in the field of gifted education who maintain that lack of challenges in the gifted education could discourage the development of their problem-solving abilities (Launder, 2011b; Manning et al., 2010).

Van Tassel-Baska and Stambaugh (2005) agree that differentiation for gifted learners in the regular classroom needs great skill on the teachers' part. For example, teachers need to manage whole class instruction at the beginning of a new concept, followed by individual discussion, small group or whole group work with varied assignments. Alternatively, teachers may choose a whole class approach to teaching a skill followed by learners working on self-selected tasks and self-evaluating their progress (Lilley, 2008).

The findings of this study also indicate that teachers feel that there are several issues that have an impact on the capacity to differentiate the curriculum. Teacher 10 mentioned that it would be a problem to cater for the needs of gifted learners as this will discourage the slow learners:

> *"I think that it will be a problem to give them more challenging activities because I think it will discourage others, the slow learners they will think others are better than them, so they must be given the same".*

In their study for serving gifted learners in the regular classroom, Van Tassel-Baska and Stambaugh (2005) reported various obstacles that lie in the way of differentiation. While it is true that the obstacles stated by the researcher apply to different kinds of populations, the researcher touched on the obstacles with particular reference to the populations that accommodate the needs of gifted learners. According to Van Tassel-Baska and Stambaugh, there is not sufficient knowledge and content management for the regular classroom teachers to facilitate the education of gifted learners. The absence of training in the management of the classroom strategies for differentiation is a factor that leads to the wrong or non-implementation of the strategy. Sisk (2009) adds that without determination and professional development in addressing gifted learners' needs, it is difficult for teachers to actually differentiate in the regular classroom. These findings contradict

the research of Westberg and Daoust (2003) who found no relationship between teachers' training and training experiences. Thus, though teachers may have more professional training, their practices do not demonstrate their further development because teachers felt that giving gifted learners challenging activities is a problem since the slow learners will be discouraged

iv) Mathematics Competitions

Most of the teachers (73.7%) who took part in the study affirmed that learners in their schools enter different competitions around the country. Teachers value the use of mathematics competitions as a strategy to support learners in their schools. Teacher 10 indicated that learners learn more when they participate in mathematics competitions with other schools:

> *"I think entering competitions and participating with other schools in mathematics. They explore when you take them somewhere so that they can learn better."*

In South African high schools, learners should have the opportunity to participate in a variety of different types of competitions. Some of these activities are offered within a school, regionally, provincially, nationally and internationally. In many schools, the more favoured competitions for mathematics learners are those organized by the Association for Mathematics Education of South Africa (AMESA) and the South African Mathematics Olympiad (SAMO). These competitions play an important role in the educational provision for gifted learners (Renzulli, 1994). The organisers also believe that learners who participate in these competitions benefit from the exposure to mathematics going beyond curriculum, which makes them to 'think out of the box'. Rather than focusing on small number of winners, participants prepare for the competitions by trying to solve problems likely to be found in the competition itself, therefore all participants increase their knowledge significantly. Weinberg et al. (2011) agree that competitions have always played a significant role on a small group of gifted learners who do not do well in the regular curriculum as they give them an alternative opportunity to show their talents and realize their high potential. Mathematical competitions also contribute to the development of

knowledge while influencing the effective or emotional component of learning environment and can raise level of learners' interest and motivation.

Mathematical competitions have a rich history in South Africa and internationally and have taken the form which accommodates different types of learners by affording them with opportunities to compete and compare their abilities with other learners. Therefore, teachers are encouraged to enter as many learners as possible for mathematical competitions, and this can often have a big impact on what happens to the gifted learners. As such, these competitions may build a positive social impact on gifted learners by improving mathematical skills which can help in different fields, and at the same time, enrich their learning experience (Petar Kenderov et al., 2009). .

v) Grouping learners

The results on the second research question, "what strategies do teachers use for supporting mathematically gifted learners?" are in contrast to what Gagné suggests in his ninth commandment. Gagné considers full-time grouping as the only way to create appropriate conditions for an enriched curriculum for the gifted learners. Although results from ability grouping studies might not be conclusive, the weight of evidence indicates that differentiation of the curriculum which was afforded through some grouping by ability level is important in catering for the needs of gifted children. Research has indicated that these manipulated grouping practices allow teachers to be more responsive to the needs of all their students, engaging in practices that reflect positive achievement outcomes for those of all abilities (Winebrenner & Brulles, 2008).

Other researchers (Gentry & MacDougall, 2008) have also confirmed that students will benefit when curriculum and instruction are adjusted to their individual level of achievement and skill. As such, there must be provision for this methodology in our schools (Biddick, 2009). Moreover, gifted students are afforded a sense of belonging, in an environment where daily and consistent interactions with intellectual peers can be maintained. They can also expect to be supported by a teacher who acknowledges and actively addresses their unique academic and

affective needs (Peters, 2005). Teachers will need to consider effective instructional strategies to meet the particular learning needs of gifted learners including enrichment and acceleration using open-ended question and incorporating high order reasoning skills. The pace of curriculum will be decided by the learner's readiness with the understanding that learners learn at different levels.

A group of researchers examined more than a century of data on the subject and came to the conclusion that putting students of similar skills and abilities together in the same class is a highly effective, low-cost method to increase educational achievement (Steenbergen-Hu, Makel, & Olszewski-Kubilius, 2016). Proponents of ability grouping, therefore, argue that these techniques greatly benefit students who are insufficiently challenged in their grade-level classroom. When classes have more students of the same ability level, it's easier for teachers to teach at a level that matches a student's needs.

vi) Teachers attitude towards gifted learners

Regarding the question about how comfortable teachers becomes when there are mathematically gifted learners in their classrooms, many of the respondents (68.4%) showed positive attitude by indicating that they feel very comfortable with the presence of some gifted learners in their regular classrooms. A noticeable percentage of teachers (21.1%) indicated that having gifted learners in their classrooms makes them fairly comfortable which shows positive attitude. About 10.5% showed that they feel neither comfortable nor uncomfortable.

The main reasons highlighted about being comfortable when having gifted learners in the mathematics classrooms were that teachers have different approaches to delivering the content, they prepare more and research on the topic to be taught, they complete the syllabus in a short period of time and they can account easily to the senior officials as they get good results.

However, Teacher 5 had a negative attitude and commended that it feels uncomfortable in the presence of gifted learners because it is anxious about being corrected by the learners for making mistakes in its teaching. Teacher 5 said:

> *"It is not that I'm comfortable because mathematically gifted learners each and every mistake or error that you commit they are on top of you. They can detect easily when you made a mistake."*

This finding in Teacher 5's case was not surprising as previous research also indicated the presence of different feelings among teachers who taught in a classroom where there is gifted learners (Galbraith, Delisle, & Espeland, 1996).

In terms of the ease or difficulty of work when having gifted learners in classrooms, 21.1% of teachers agreed that their work is easier with the presence of gifted learners in their classrooms. The majority of participants (36.8%) indicated that gifted learners make teaching easier and another 36.8% showed that the presence of these learners neither makes teaching easier nor difficult.

Teachers commented on the level of ease when having gifted learners in their classrooms. The main reasons highlighted by the teachers were that the performance of gifted learners makes reporting to the seniors easier, teachers do not struggle to explain concepts to these learners, they do not have to explain one thing over and over again to the gifted ones, these learners are able to share their understanding with the rest of the class, and their participation encourage and motivate teachers.

The way individual teachers view their work in educating learners makes the difference in the education of gifted learners. Teachers' thinking seemed to be linked to their feelings and their doing of the work as a job or bringing fun from doing the work to cater the needs of all learners. When teachers work hard to meet the needs of all learners in their classrooms, they may feel comfortable in the presence of the gifted learners. On the other side, there might not be any joy in the work which tended to be done as a job if a teacher feels uncomfortable in front of the gifted learners. While learners have the potential to learn and change, teachers also have the potential to learn and be the agents to bring about a transformation for the betterment of themselves and the learners.

The findings on the attitudes of teachers showed mixed results with both positive and negative attitudes towards mathematically gifted learners. These mixed attitudes are similar to views expressed from respondents in previous studies (Allodi & Rydelius, 2012; Lassig, 2015b; Perković Krijan et al., 2015)

5.2.3 To what extent are teachers' strategies meeting the needs of the gifted learners?

i) Teachers' beliefs about the impact of their teaching strategies on gifted learners

Most teachers (94.7%) appear to believe that their teaching strategies address the needs of the gifted learners well in their classrooms. Only 5.3% indicated that the needs of gifted learners were very poorly addressed in their schools. Furthermore, teachers feel that their strategies have the same impact on all learners and are mainly influenced by the conditions of their classrooms. Teacher 9 mentioned that the teaching strategies were primarily aimed at those learners that were struggling as they also wanted them to pass:

> *"Of the number of gifted learners, we have, we also have the number of average learners, our teaching strategies are primarily based on those learners who are weak. So in the classroom, you will do those basic things that require a basic understanding."*

Teacher 10 appeared to agree that the teaching strategies impact gifted learners differently with regard to academic achievement, the teacher adds that some learners underperform because they do not practice mathematics:

> *"It differs, others pass, and others underperform. I've noticed that others they don't practice. If they are going to write a test you have to push them, when they are at home they don't do their work."*

However, do all the aforesaid mean that no good strategies exist for mathematically gifted learners in the regular classrooms? It was, in fact, revealed that most teachers appeared not to make provision for mathematics. It was explained in Chapter 2 that mathematically gifted learners have special abilities such as a mathematical cast of mind (Krutetskii, 1977) and a logical-mathematical intelligence (Gardner, 1983) that

form mathematical intelligence. In order for mathematical intelligence to be developed, specific provision is needed (Gardner & Moran, 2006; Gardner, 2011) such as content-specific (VanTassel-Baska, 2007) and subject-specific provision (Koshy, 2013). These results indicated that teachers do not make specific provision for mathematically gifted learners in their classrooms. Therefore, although this is enough not only to prove that the strategies of the teachers do not effectively meet the needs of gifted learners in their classrooms, it does also indicate that there is an awareness that these gifted learners need to be identified and consequently catered for within mathematics classrooms in high schools.

ii) Teachers need support

With regard to teachers of mathematically gifted learners, the study revealed that the majority of teachers (73.7%) need extra support to address the needs of mathematically gifted learners in their regular classrooms. These teachers suggested one or more areas in which they would like to have extra support. Most of the teachers appear to ask for more support (34.4%) in teaching materials for gifted learners, while there are also many teachers who indicated that they need to be supported in monitoring gifted learners' progress (28.1%), supporting gifted learners outside classroom (21.9%) and supporting gifted learners in classroom (9.4%).

The final theme focused on support that teachers need to teach gifted learners. When teachers asked what kind of support they would find helpful, they approached the question by pointing out some of the challenges teachers face in the classrooms. Respondents felt that having mathematically gifted learners in the classrooms make teaching more challenging as thorough preparation is required to challenge these learners. One of the respondents said sometimes she is not confident in teaching other topics in mathematics.

It is interesting that several respondents expressed positively that there was a need for teachers to have workshops in terms of teaching gifted learners. Furthermore, other teachers highlighted the need of being supported in terms of technology (to enable them to utilize mathematical tools on computers) and other resources like teaching material to enable them to teach gifted learners. In addition, other teachers

would like to have the gifted learners separated from the average performing learners and work with them separately because it is difficult to work with 40 learners in a mixed class.

Research conducted in other countries shows that teachers' views of gifted learners can influence both the identification process and the support that they provide in the classroom (Geake & Gross, 2008). Since the interviewed teachers mentioned that they attend different kinds of trainings and workshops, locally and provincially about struggling learners, they suggested the need for more useful workshops in the gifted education. Some teachers mentioned that for such teacher training, the emphasis should be equal to teaching both the gifted and slow learners. Koshy and Casey (2005) have indicated that training workshops which give teachers the opportunity to discuss the complexities of the concept of giftedness and ways to support gifted learners can influence their classroom teaching practice. Teachers consider the help they get from other mathematics teachers very important for overcoming abovementioned challenges.

For in-classroom support, Teacher 5 who taught large classes with an average of forty learners in which there were different level of ability-gifted learners, average performing learners and slow learners, stated that it was a bit difficult to work with such learners in one classroom. Teacher 5 also suggested that having gifted learners in their own classroom could help teachers to offer more focused attention to gifted learners. In addition, Teacher 2 felt that teachers should help one another in the classrooms to present those topics that they struggle with. Teacher 2 mentioned that teachers do not make justice to the learners. However, when voiced by teachers, such claims may be heard by policy-makers as attempts to teach few learners and do less work. But the important point is for the policy-makers to acknowledge that gifted learners need learning opportunities that are faster paced and more complex than what is being taught in the regular classroom, and Sheffield (2002) contends that the teacher alone cannot serve their special needs effectively.

However, the fact that there are many teachers who do not have gifted education training and specialists in their schools to organize and differentiate mathematics lessons in classrooms for gifted learners, the Hyde (2008) report suggests that more

effort is needed from policy-makers. These teachers may need some kind of support to design a policy for provision from a specialist in order to assist them to plan mathematics lessons at the higher order for gifted learners. Additionally, any kind of support offered for teachers should go hand in hand with a programme for teachers' professional development (Dimitriadis, 2010)

5.3 Conclusion

5.3.1 About identifying mathematically gifted learners

According to the teachers, it seems that identification of mathematically gifted learners is merely based on academic tests. The heavy reliance on academic tests with regard to the identification process is due to a narrow definition of the nature of mathematically promising learners. Teachers should be encouraged to look for other methods like nomination by parents and by other teacher or previous school, discussions with learners, learner tracking and assessment work, and also by observing learners during the question and answer sessions.

5.3.2 About supporting mathematically gifted learners

Along with enrichment, acceleration, differentiation, mathematics competitions and grouping strategies, this study revealed that teachers believed more work and challenging activities are necessary for gifted learners to improve mathematical skills and reasoning ability. While regular education teachers recognized the need for a challenge in their classrooms, the study revealed that they struggled to provide gifted learners with suitable challenging work. Although there were suggestions that some strategies to support learners were available, provision in terms of gifted education did not seem to be in operation. The study shows that further study should be conducted to uncover the willingness of teachers to support gifted learners in their mathematics classrooms. More research may also be important to provide meaningful insights into why teachers are not willing to provide gifted learners with challenging activities. The situations that demand educating gifted learners in the regular classrooms need to change. This can be done by training pre-service teachers and in-service teachers to

find and utilize strategies that meet the needs of mathematically gifted learners in their classrooms.

5.3.3 About the impact of teachers' strategies on mathematically gifted learners

With regard to the nature of support that gifted learners receive from teachers, there was a perceived lack of extra programmes for gifted learners which was highlighted by the teachers. Possibly a major weakness in supporting mathematically gifted learners is the lack of differentiated curriculum within the classroom where the learners spend most of their time. Research suggests that many teachers in the regular classrooms have the same difficulties, as often thinking that gifted learners are able to provide themselves with challenging work they need (Manning et al., 2010).

Teachers' ongoing professional workshops and training in gifted education also seem to be a factor that influence the impact of teachers' strategies on gifted learners. Lack of gifted education affects teachers in terms of organizing challenging and differentiated lessons for gifted learners. Teachers themselves indicated that their professional development and workshops play an important role in the effectiveness of support that gifted learners may receive in the regular classrooms. Regardless of teachers' training background, there are many teachers who would like to be supported more in teaching materials for gifted learners, monitoring gifted learners' progress and also in supporting gifted learners outside classrooms.

5.4 Recommendations

The focus on a one–dimensional statistical view of identifying gifted learners using academic tests alone has been challenged by the international researchers. Teachers should be aware of other multidimensional system of identification which includes nomination by teachers, peer groups, parents and the learners themselves.

Even though the teachers were aware that mathematically gifted learners should be given more challenging tasks than their classmates, the teachers do not know how to

assess these students in the regular classroom settings. The current strategies that teachers use to support gifted learners in their classrooms have been found to be inadequate. Curriculum differentiation needs serious attention. Therefore, this study recommends that the curriculum should be revised and include strategies which are aimed at developing mathematically gifted learners in the regular classrooms. Adopting these strategies could not only uplift the level of learning of all learners, it could, in fact, reveal more unnoticed gifted learners. Strategies such as compacting the curriculum should motivate learners to focus on their lessons while they enjoy the challenging activities as mentioned in the teacher responses to the interview.

Having gifted learners in regular classrooms is highly complex and challenging, therefore teachers should have the knowledge and confidence to teach these learners. Teacher preparation in gifted education should be made available at both pre-service and in-service training. The Department of Basic Education jointly with the Department of Higher Education (DHET), and the policy administrators should make sure that adequate resources – both financial and professional, are made available.

Gifted education is not just about identifying gifted learners but is also about encouraging gifted behaviors in all learners. The role of teachers and parents is a well-established fact in encouraging gifted learners, in particular, the involvement of parents with teachers to support their learners at home, thus gifted learners may need specific support even out of the classroom.

Finally, gifted learners exist in all regular mathematics classrooms and in all racial, cultural and economic states. It is the duty of the role players in education-including teachers and parents to search for submerged gifts wherever they may exist and support them.

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APPENDICES

Appendix A: The Questionnaire Survey

The Questionnaire Survey
The Cover Letter

STRATEGIES USED BY TEACHERS FOR SUPPORTING MATHEMATICALLY GIFTED LEARNERS IN TEN SELECTED HIGH SCHOOLS AROUND BLOEMFONTEIN

Dear Respondent

My name is Jack Mathoga Marumo and I am a postgraduate student at the Central University of Technology, Bloemfontein. For my project, I am investigating strategies which teachers use when they support mathematically gifted learners in their inclusive classrooms. Because you are a teacher in the field of mathematics, I am inviting you to participate in this research by completing the attached survey.

The entire survey will take approximately 15 minutes of your time, but may result in huge difference measured in years – not in minutes for our teachers and learners. Participation is strictly voluntary and there is no compensation nor is there any known risk. Please do not include your name in order to ensure that all information is treated with confidentiality.

Thank you for helping me by taking your time to complete this survey. To help me better our education service, I rely on you in filling the survey and returning it to me.
If you require additional information about this research, please contact me at the email or number listed below.

Sincerely,

Jack Mathoga Marumo
(Student)
marumojm@hotmail.com

Professor MK Mhlolo
(Supervisor)
mmhlolo@cut.ac.za

1

The Questionnaire

Please tick ☒ the most appropriate response when answering the questions apart from those that indicated otherwise or/and write in the spaces provided.

SECTION 1: BIOGRAPHIC INFORMATION

1.1 What is your gender?

Male ☐

Female ☐

1.2 How old are you?

Below 25 ☐

Between 26 and 35 ☐

Between 36 and 45 ☐

Between 46 and 55 ☐

Above 55 ☐

1.3 What is your level of education?

Certificate ☐

Diploma ☐

Degree ☐

1.4 What is your current position in the school?

Mathematics teacher ☐

Head of Department ☐

Principal ☐

Other ☐

If **other**, please specify _____

1.5 For how long have you been in the current position?

Below 5 years..... ☐

Between 5 and 9 years..... ☐

Between 10 and 14 years..... ☐

Between 15 and 20 years..... ☐

Above 25 years..... ☐

1.6 Have you ever received or attended any training in teaching mathematics?

Yes..... ☐

No..... ☐

Not sure..... ☐

If **yes**, what kind of training? (You may choose more than one answer)

General teaching practices..... ☐

Teaching less able or underachieving learners..... ☐

Teaching disabled learners..... ☐

Teaching more able (gifted and talented) learners..... ☐

Other (please specify below)..... ☐

.....

SECTION 2: ABOUT IDENTIFYING MATHEMATICALLY GIFTED LEARNERS

2.1 How many learners are enrolled in your mathematics classroom?.....

2.2 What kind of a classroom is your mathematics classroom?

Mixed ability classroom..... ☐

Special classroom for slow learners ..... ☐

Special classroom for fast learners ..... ☐

3

2.3 Do you have gifted learners in your mathematics classroom?

Yes.....☐

No.....☐

Not sure.....☐

2.4 Does your school have a policy to identify and develop gifted and talented learners?

Yes.....☐

No.....☐

Not sure.....☐

2.5 Do you have a separate register in your school or classroom for mathematically gifted learners?

Yes.....☐

No.....☐

Not sure.....☐

2.6 Which method do you use to identify gifted learners in your mathematics classroom?

a. Nominations? (Choosing a learner as viewed to be gifted. For example, observing the learner's performance during question and answer sessions)

Yes.....☐

No.....☐

Not sure.....☐

If **yes**, please explain how you nominate mathematically gifted learners.....

.....

.....

4

b. Assessment results

Yes..... ☐

No..... ☐

Not sure..... ☐

If **yes**, please explain how you use test results to identify mathematically gifted learners.....

.....

.....

c. Identification by other teacher or previous school.

Yes..... ☐

No..... ☐

Not sure..... ☐

d. Identification by parents.

Yes..... ☐

No..... ☐

Not sure..... ☐

e. Other methods

Yes..... ☐

No..... ☐

Not sure..... ☐

If **yes**, please specify below.....

.....

5

2.7 How would you evaluate the identification process of mathematically gifted learners in your classroom?

Easy ☐

Very easy ☐

Neither easy nor difficult ☐

Difficult ☐

Very difficult ☐

SECTION 3: ABOUT SUPPORTING MATHEMATICALLY GIFTED LEARNERS

3.1 Do your learners in classroom have a preference for individual or group work?

Yes ☐

No ☐

3.2 How do you group learners in your classroom?

By ability grouping ☐

In mixed ability groupings ☐

Other grouping ☐

If **other grouping**, please specify .....

.....

3.3 How often do you change learners' grouping in your classroom?

Sometimes ☐

Never ☐

If **sometimes**, please explain why .....

.....

.....

6

3.4 Do you motivate learners in your classroom?

Yes..... ☐

No..... ☐

If **yes**, please tell how effective the motivation is .....

.....

.....

3.5 Do leaners in your classroom have mathematics portfolios?

Yes..... ☐

No..... ☐

Not sure..... ☐

If **yes**, how do they benefit you and the learners? .....

.....

.....

3.6 Do learners in your school participate in mathematics competitions?

Yes..... ☐

No..... ☐

If **yes**, what kind of competitions (for example, SA Maths Olympiad).....

.....

.....

SECTION 4: ABOUT YOU AS A TEACHER OF MATHEMATICALLY GIFTED LEARNERS

4.1 How comfortable are you in teaching mathematically gifted learners?

Very comfortable..... ☐

Fairly comfortable..... ☐

Neither comfortable nor uncomfortable..... ☐

Fairly uncomfortable..... ☐

Very uncomfortable..... ☐

4.2 Mathematically gifted learners make your teaching in the classroom

Easy ☐

Very easy ☐

Neither easy nor difficult ☐

Difficult ☐

Very difficult ☐

Please explain .....

.....

.....

4.3 How well do you think the needs of mathematically gifted learners are addressed in your school

Very well ☐

Well ☐

Adequately ☐

Poorly ☐

Very poorly ☐

4.4 Do you feel you need extra support regarding gifted learners?

Yes ☐

No ☐

Not sure ☐

If **yes**, in which areas? (You may choose more than one answer)

Teaching materials for gifted learners ☐

Identifying gifted learners ☐

Supporting gifted learners in classroom ☐

Supporting gifted learners outside classroom ☐

Monitoring gifted learners' progress ☐

Appendix B: Teacher Interview Questions

Themes	Questions
1. Identification process	1.1. Do you have gifted learners in your classroom? 1.2. When did you realize that you have mathematically gifted learners in your classroom? 1.3. How have you identified gifted learners in your classroom? 1.4. Why do you feel that the process of identifying gifted learners was easy or difficult (depending on the teacher's written response)
2. Teaching mathematically gifted learners	2.1. What resources do you use to teach your students? 2.2. How do you assess gifted learners in your classroom? 2.3. Do you feel that gifted learners should be given the same or more challenging activities than their classmates? 2.4. Why do you feel that gifted learners should be given the same (or more depending on the previous answer) challenging activities than their classmates? 2.5. Why do you feel that having gifted learners in your classroom makes your work easy (or difficult depending on the written answer) 2.6. What makes you comfortable (or uncomfortable depending on the written answer) when teaching mathematically gifted learners
3. Supporting mathematically gifted learners	3.1. What do you think are the best strategies to support gifted learners? 3.2. What do you think is the impact of your teaching strategies on gifted learner's achievement?
4. Supporting teachers of gifted learners	4.1. What kind of support or training would you find appropriate regarding teaching gifted learners?

Appendix C: Application to the principals to conduct research

11 July 2016

To: The Principal of the school

Permission to conduct the study : Strategies Used By Teachers For Supporting Mathematically Gifted Learners In Ten Selected High Schools Around Bloemfontein

Dear Sir/Madam

This letter serves as a **request** to conduct the study at your institution/school. The process (conduction of this study) will include the questionnaire survey and the interview of teachers (minimum of 2).

This study will contribute in improving and increasing the knowledge of teachers towards handling, educating and supporting gifted learners in their regular classes. It (this study) can furthermore be used as a guide/ aid towards enhancing policy matters relating to education of this group of learners.

This study will strive to minimise the disruption of teaching and learning time, as such, these interviews will either be conducted during break(lunch time) or after school, while questionnaires can be taken and completed at home by teachers.

For any clarity, please feel free to contact me at the email or number below.

Thank you for your cooperation

Regards

Jack Mathoga Marumo	Professor MK Mhlolo
(Student researcher)	(Supervisor)
marumojm@hotmail.com	mmhlolo@cut.co.za

Appendix C: Application to the Department of Education to conduct research

Ref: Research Application

APPLICATION TO REGISTER AND CONDUCT RESEARCH IN THE FREE STATE DEPRARTMENT OF EDUCATION

- Please complete all the sections of this form that are applicable to you. If any section is not applicable please indicate this by writing N/A.
- If there are too few lines in any of the sections please attach the additional information as an addendum.
- Attach all the required documentation so that your application can be processed.
- Send the completed application to:

DIRECTOR: STRATEGIC PLANNING, POLICY AND RESEARCH

Room 319, 3rd Floor
Old CNA Building
Bloem Plaza
Charlotte Maxeke Street
BLOEMFONTEIN, 9300

OR

Free State Department of Education
Private Bag X20565
BLOEMFONTEIN, 9300

Email: berthakitching@gmail.com and research@edu.fs.gov.za
Fax: 086 692 9092
Tel: 051 404 9283 /9211

1. **TITLE** (eg Ms, Mrs, Mr, Dr, Prof, etc):

2. **INITIALS**

3. **SURNAME**

4. **TELEPHONE HOME:**

5. **TELEPHONE WORK:**

6. **TELEPHONE CELL:**

7. **FAX:**

8. **E-MAIL**

9. **ADDRESS HOME:**

Postal Code

10. **ADDRESS WORK:**

Postal Code

11. POSTAL ADDRESS

Postal Code														

12 **NAME OF TERTIARY INSTITUTION / RESEARCH INSTITUTE AND STUDENT NUMBER**

13. OCCUPATION

14. PLACE OF EMPLOYMENT

15. NAME OF COURSE

16. NAME OF SUPERVISOR / PROMOTER

17. TITLE OF RESEARCH PROJECT

18. CONCISE EXPLANATION OF THE RESEARCH TOPIC

19. APPLICATION VALUE THAT THE RESEARCH MAY HAVE FOR THE FREE STATE EDUCATION DEPARTMENT

20. LIST OF SCHOOLS AND DISTRICTS INVOLVED IN THE RESEARCH
(If not enough space, please attach addendum)

21. LIST OF DIRECTORATES / OFFICIALS IN THE DEPARTMENT INVOVLED IN THE RESEARCH

22. DETAILS OF TARGET GROUP WITH WHOM THE RESEARCH IS TO BE UNDERTAKEN

Target group	Number	Grade	Subject	Age	Gender	Language

23. FULL PARTICULARS OF HOW INFORMATION WILL BE OBTAINED, EG QUESTIONAIRES, INTERVIEWS, STANDARDIZED TESTS, ETC.

Please attach copies of questionnaires, questions that will be asked during interviews, tests that will be completed or any other relevant documents regarding the acquisition of information.

24. STARTING AND COMPLETION DATES OF THE RESEARCH PROJECT

Please bear in mind that research is usually not allowed to be conducted in schools during the fourth academic term (October to December).

25. WILL THE RESEARCH BE CONDUCTED DURING OR AFTER SCHOOL HOURS?

Please bear in mind that research is usually not allowed to be conducted in schools during normal teaching time.

26. HOW MUCH TIME IS NEEDED WITH THE TARGET GROUP/S TO CONDUCT THE RESEARCH?

Target Group	Activity (ie interview, questionnaire, etc)	Time Needed

27. HAVE YOU INCLUDED / ATTACHED?

27.1 A letter from your supervisor confirming your registration for the course you are following?

Yes	No

27.1 A draft letter / specimen that will be sent to principals requesting permission to conduct research in their schools?

Yes	No

27.2 A draft letter / specimen that will be sent to parents requesting permission for their children to participate in the research project?

Yes	No

27.3 A copy of the questionnaires that you wish to distribute to the target group/s?

Yes	No

27.4 A list of questions that will be asked during interviews with the target group/s?

Yes	No

28 I …… herewith confirm that all the information in this application form is correct and that I will abide by the ethical code and the conditions under which the research may be undertaken, ie:

28.1 I will abide by the ethical research conditions in the discourse of my study in the FSDoE.

28.2 I will abide by the period in which the research has to be done

28.3 I will apply for extention if I cannot complete the research within the specified period

28.4 If I fall behind with my schedule by three months to complete my research project in the approved period, I will apply for an extension.

28.5 I will not conduct research during the fourth quarter of the academic year

28.6 I will not disrupt normal learning and teaching times at schools to undertake my research

28.7 I will submit a bound copy or CD of the research document to the Free State Department of Education, Room 319, 3rd Floor, Old CNA Building, Charlotte Maxeke Street, Bloemfontein, upon completion of the research.

28.8 I will upon completion of my research study make a presentation to the relevant stakeholders in the Department as per the arrangements of the Department.

28.9 The ethics documents will be adheared to in the discourse of my study in your department.

28.10 The costs relating to all the conditions mentioned above are for my own responsibility.

SIGNATURE: _____ DATE: _____

Appendix D: Approval to conduct research

education
Department of Education
FREE STATE PROVINCE

Enquiries: BM Kitching
Ref: Research Permission: MJ Marumo
Tel. 051 404 9283 / 9221 / 082 454 1519
Email: berthakitching@gmail.com and B.Kitching@edu.fs.gov.za

MR MJ MARUMO
11 PRUIMBOS STREET
LOURIERPARK
BLOEMFONTEIN, 9301

APPROVAL TO CONDUCT RESEARCH IN THE FREE STATE DEPARTMENT OF EDUCATION

1. This letter serves as an acknowledgement of receipt of your request to conduct research in the Free State Department of Education.

   Research Topic: Strategies used by teachers for supporting mathematically gifted learners in ten selected high schools around Bloemfontein.

   Approval is herewith granted to conduct research in Bloemfontein High School, Bloemfontein South, Brebner, Sentraal, Moemedi, Navalsig, Sehunelo, St Bernard's and Tsoseletso Secondary Schools and Kagisho Combined School, in Motheo District.

   Target Population: 20 Grade 8 Mathematics Teachers.

2. **Period of research**: From the date of signature of this letter until 30 September 2016. Please note the department does not allow any research to be conducted during the fourth term (quarter) of the academic year, nor during school hours.
3. Should you fall behind your schedule by three months to complete your research project in the approved period, you will need to apply for an extension.
4. The approval is subject to the following conditions:
   - 4.1 The collection of data should not interfere with the normal tuition time or teaching process.
   - 4.2 A bound copy of the research document or a CD, should be submitted to the Free State Department of Education, Room 319, 3rd Floor, Old CNA Building, Charlotte Maxeke Street, Bloemfontein.
   - 4.3 You will be expected, on completion of your research study to make a presentation to the relevant stakeholders in the Department.
   - 4.4 The attached ethics documents must be adheared to in the discourse of your study in our department.
5. Please note that costs relating to all the conditions mentioned above are your own responsibility.

Yours sincerely

DR JEM SEKOLANYANE
CHIEF FINANCIAL OFFICER

DATE: 01/08/2016

RESEARCH APPLICATION MJ MARUMO PERMISSION JULY 2016
Strategic Planning, Policy & Research Directorate
Private Bag X20565, Bloemfontein, 9300 - Room 318, Old CNA Building, 3rd Floor, Charlotte Maxeke Street, Bloemfontein
Tel: (051) 404 9283 / 9221 **Fax:** (086) 6678 678

education
Department of Education
FREE STATE PROVINCE

Enquiries: BM Kitching
Ref: Notification of research: MJ Marumo
Tel. 051 404 9221 / 082 454 1519
Email: berthakitching@gmail.com and B.Kitching@fseducation.gov.za

The Acting District Director
Motheo District

Dear Mr Moloi

NOTIFICATION OF A RESEARCH PROJECT IN YOUR DISTRICT BY MJ MARUMO

1. The abovementioned candidate was granted permission to conduct research in your district as follows:

   Topic: Strategies used by teachers for supporting mathematically gifted learners in ten selected high schools around Bloemfontein.

   Schools involved: Bloemfontein High School, Bloemfontein South, Brebner, Sentraal, Moemedi, Navalsig, Sehunelo, St Bernard's and Tsoseletso Secondary Schools and Kagisho Combined School, in Motheo District.

   Target Population: 20 Grade 8 Mathematics Teachers.

   Period: From the date of signature of this letter until 30 September 2016. Please note the department does not allow any research to be conducted during the fourth term / academic quarter of the year, nor during normal school hours.

2. **Research benefits:** The research will contribute in improving and increasing the knowledge of teachers towards handling, educating and supporting gifted learners in their regular classes. The study can furthermore be used as a guide / aid towards enhancing policy matters relating to education of this group of learners. The research will also contribute to the conceptualization of giftedness and talent and also improve the results of Free State Education.
3. Logistical procedures were met, in particular ethical considerations for conducting research in the Free State Department of Education.
4. The Strategic Planning, Policy and Research Directorate will make the necessary arrangements for the researcher to present the findings and recommendations to the relevant officials in your district.

Yours sincerely

DR JEM SEKOLANYANE
CFO

DATE: 01/08/2016